

# 6 Regressió generalitzada I

Mètodes empírics 2

16/05/2022

# Avui

- Cas d'estudis
- Límits de models lineals
- Generalització

# Gestos a través de contextos i cultures

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Brown et al. (to appear): Iconic gestures are modulated by social context: A study of multimodal politeness across two cultures. *Gesture*.

**Vols saber quins factors (no) afecten el nombre de gestos que fa una persona de mitjana en una conversa. Un col·lega t'ha donat les dades següents:**

**<https://tinyurl.com/gestures-data>**

- 1. Descriu les dades**
- 2. Descriu com penses que les variables es podrien relacionar**
- 3. Quins valors poden tenir les variables del teu interès?**

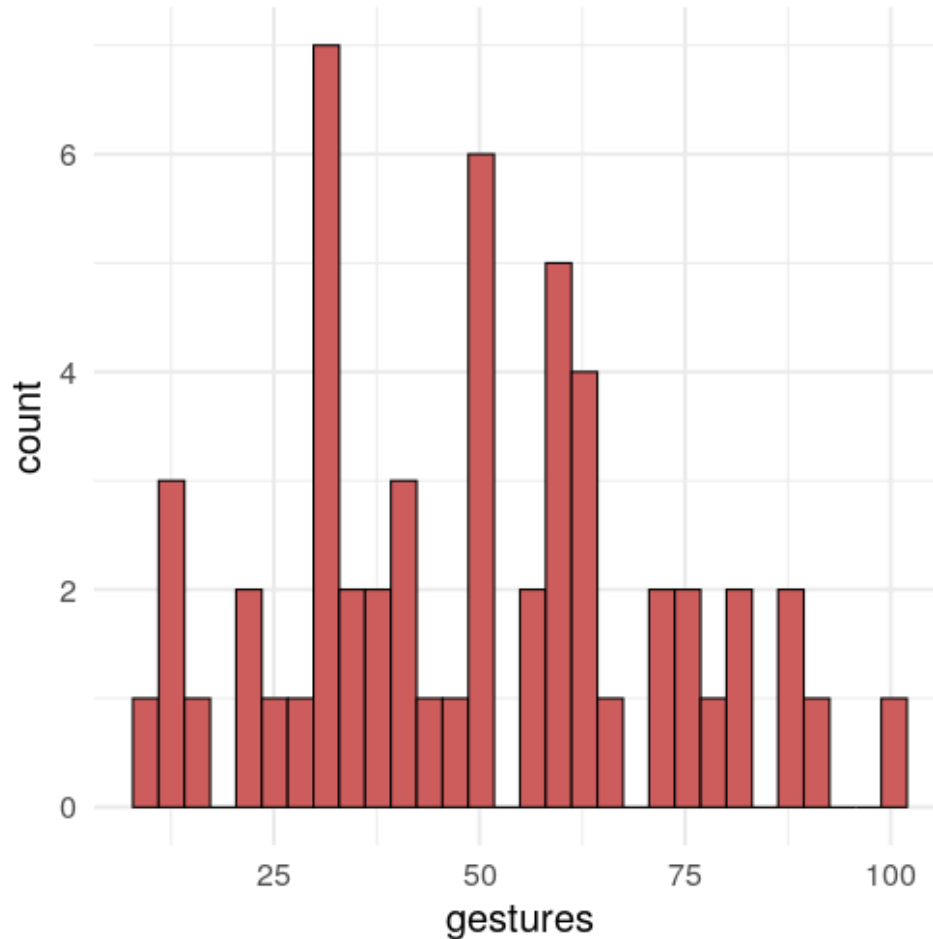
# Dades

##	ID	context	dur	language	gender	gestures
## 1	Catalan_1	friend	137	Catalan	M	61
## 2	Catalan_1	prof	136	Catalan	M	78
## 3	Catalan_2	friend	90	Catalan	F	31
## 4	Catalan_2	prof	107	Catalan	F	40
## 5	Catalan_3	friend	181	Catalan	M	81
## 6	Catalan_3	prof	165	Catalan	M	49

# Variables independents (possibles predictors)

- gender: M o F
- context: friend o prof
- language: Catalan o Korean

# Variable dependent (resultat)



# Variable dependent (resultat)

```
##      [1] 61 78 31 40 81 49 32 49 39 32 35 30 88 73 59 47 22
```



# Limits de models lineals

$$y_i \sim \text{Normal}(\mu_i, \sigma)$$

---

$$y_i \sim \text{Poisson}(\lambda_i)$$

$$y_i \sim \text{Bernoulli}(p_i)$$

# Model lineal

$$y_i \sim \text{Normal}(\mu_i, \sigma)$$

$$\mu_i = \beta_0 + \beta_1 x_1 + \dots + \beta_n x_n$$

# Model lineal generalitzat: Normal

$$y_i \sim \text{Normal}(\mu_i, \sigma)$$

$$\mu_i = f(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)$$

$$f(x) = x$$

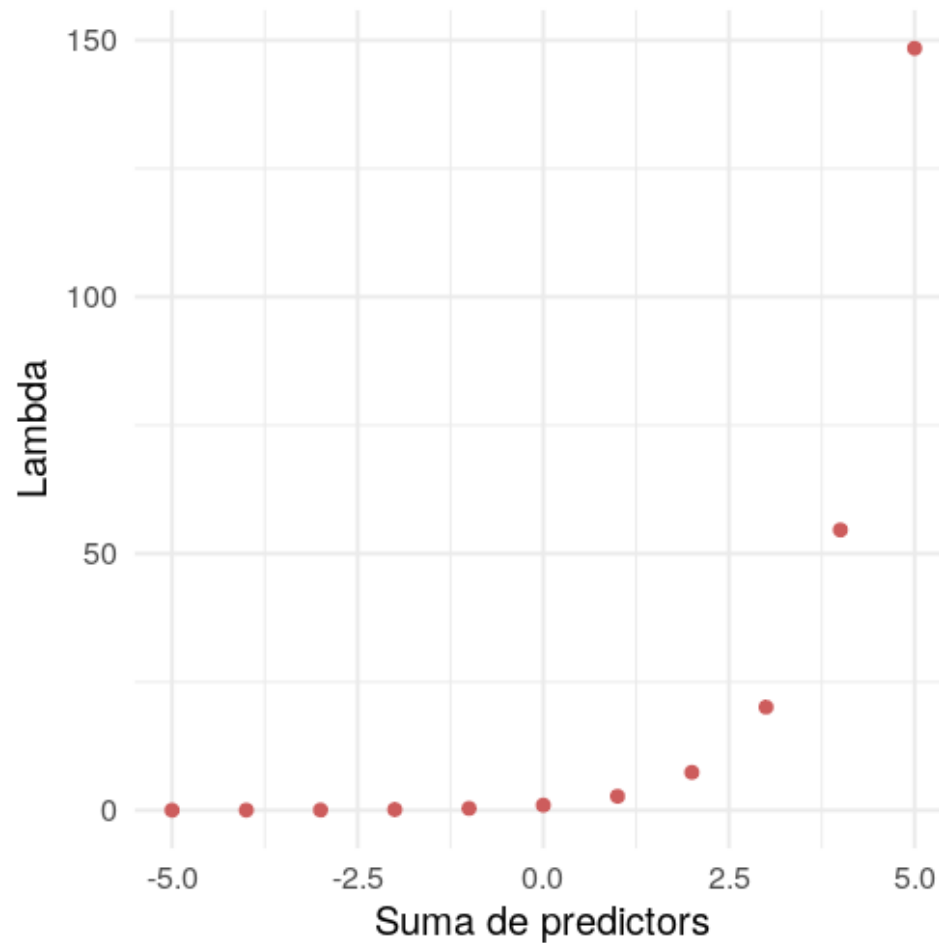
# Model lineal generalitzat: Poisson

$$y_i \sim \text{Poisson}(\lambda_i)$$

$$\lambda_i = f(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)$$

$$f(x) = \exp(x)$$

# Espai exponencial



# Model lineal generalitzat: Poisson

$$y_i \sim \text{Poisson}(\lambda_i)$$

$$\lambda_i = \exp(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)$$

# Model lineal generalitzat: Poisson

$$y_i \sim \text{Poisson}(\lambda_i)$$

$$\log(\lambda_i) = \beta_0 + \beta_1 x_1 + \dots + \beta_n x_n$$

# Link functions canòniques

**Normal:** Identitat

$$f(x) = x$$

**Poisson:** Logaritme

$$f(x) = \exp(x)$$

**Bernoulli/Binomial:** Logit

$$f(x) = \frac{\exp(x)}{1 + \exp(x)}$$



# Regressió de Poisson (R)

```
glm(formula = gestures ~ 1 + language,  
    data     = df,  
    family   = poisson(link = 'log')  
)
```

# Gestos a través de contextos i cultures

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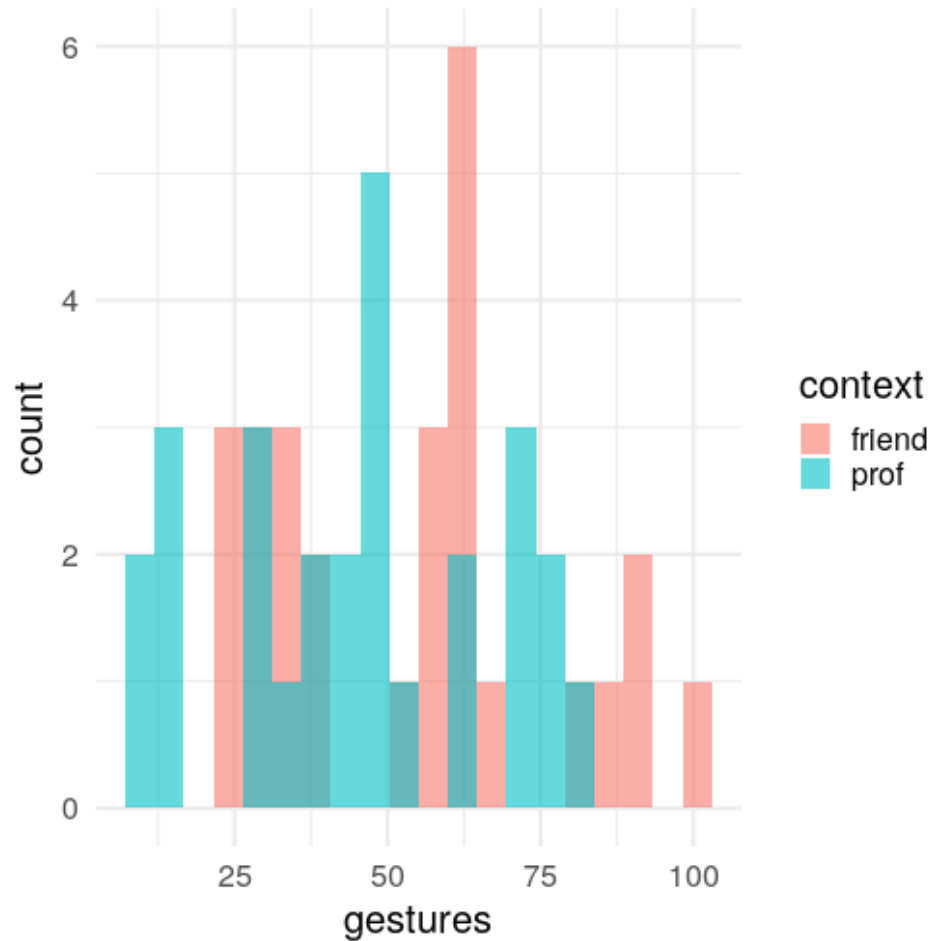
Brown et al. (to appear): Iconic gestures are modulated by social context: A study of multimodal politeness across two cultures. *Gesture*.

# Dades

```
head(df)
```

##	ID	context	dur	language	gender	gestures
## 1	Catalan_1	friend	137	Catalan	M	61
## 2	Catalan_1	prof	136	Catalan	M	78
## 3	Catalan_2	friend	90	Catalan	F	31
## 4	Catalan_2	prof	107	Catalan	F	40
## 5	Catalan_3	friend	181	Catalan	M	81
## 6	Catalan_3	prof	165	Catalan	M	49

# Gestos ~ Context



# Model 1: Context

```
m1_context <- glm(formula = gestures ~ 1 + context,  
                  data     = df,  
                  family   = poisson(link = 'log')  
                  )  
  
coef(m1_context)
```

```
## (Intercept) contextprof  
##      3.9855488  -0.1772416
```

---

$$\lambda_i \approx \exp(3.99 - (\text{polite} \times 0.18))$$

# Model 1: Context

$$\lambda_i \approx \exp(3.99 - (\text{polite} \times 0.18))$$

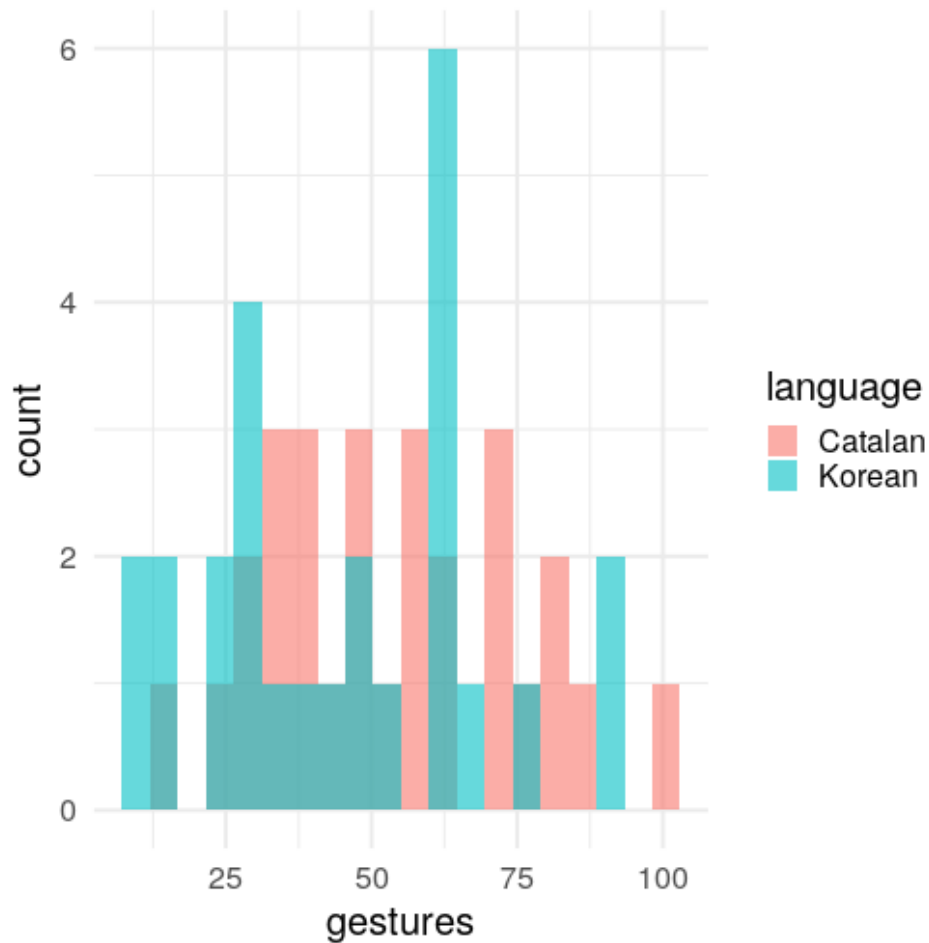
```
exp(3.99 - 0.18) #expected gestures in polite context
```

```
## [1] 45.15044
```

```
exp(3.99) #expected gestures in informal context
```

```
## [1] 54.05489
```

# Gestos ~ Llenguatge



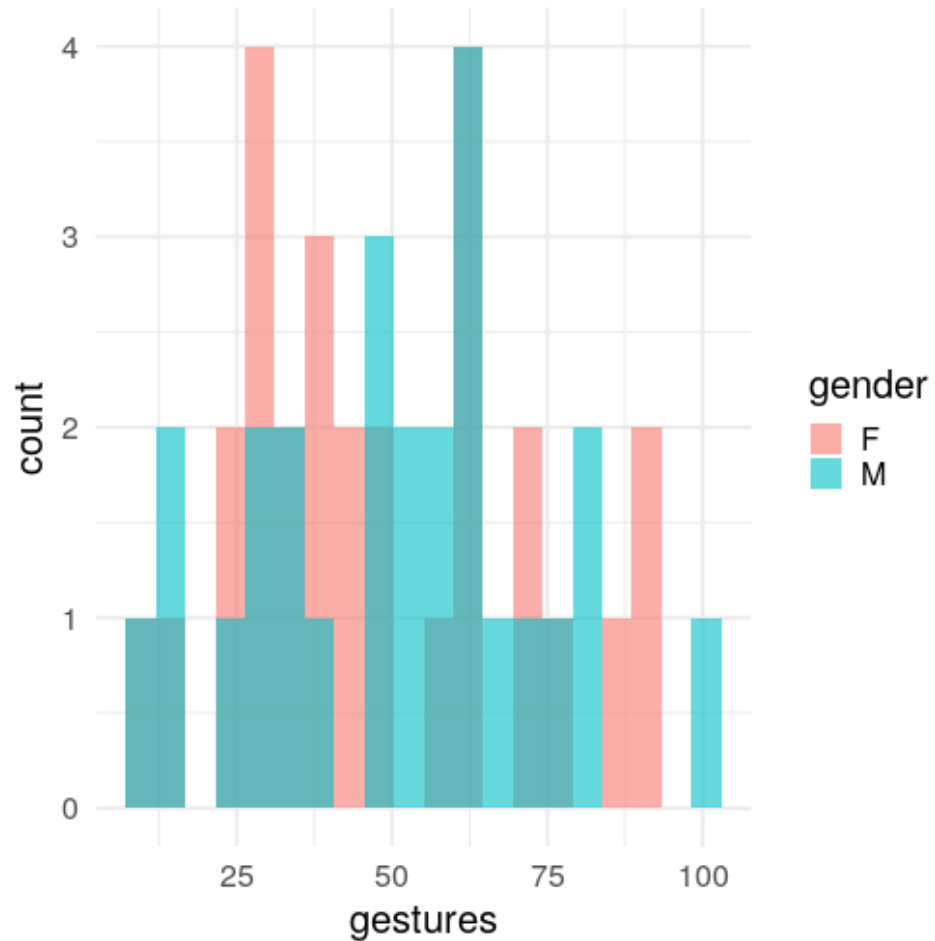
# Model 2: Llenguatge

```
m2_lleng <- glm(formula = gestures ~ 1 + language,  
                 data    = df,  
                 family  = poisson(link = 'log')  
                 )  
  
coef(m2_lleng)
```

```
##      (Intercept) languageKorean  
##      3.9796817      -0.1713112
```



# Gestos ~ Gènere



# Modelo 3: Gènere

```
m3_gen <- glm(formula = gestures ~ 1 + gender,  
              data    = df,  
              family  = poisson(link = 'log')  
              )
```

```
coef(m3_gen)
```

```
## (Intercept)      genderM  
##  3.88082715    0.04114619
```

# summary(m1\_context)

```
##
## Call:
## glm(formula = gestures ~ 1 + context, family = poisson(link = "log"),
##      data = df)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q        Max
## -6.3272  -2.8687   0.4296   1.6026   5.7274
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   3.98555    0.02623 151.923  < 2e-16 ***
## contextprof  -0.17724    0.03886  -4.561 5.08e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 583.97  on 53  degrees of freedom
## Residual deviance: 563.08  on 52  degrees of freedom
## AIC: 870.22
##
## Number of Fisher Scoring iterations: 4
```

# Akaike Information Criterion (AIC)

- Estimació de predicció fora de mostra (out of sample prediction)
- Serveix de rànkings relatiu a altres models (que van veure les mateixes dades)
- AIC més baix  $\Rightarrow$  millor

# summary(m2\_lleng)

```
##
## Call:
## glm(formula = gestures ~ 1 + language, family = poisson(link = "log"),
##      data = df)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -6.6496  -2.6240  -0.4041   2.4834   6.0006
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    3.97968    0.02584 154.030  < 2e-16 ***
## languageKorean -0.17131    0.03900  -4.393 1.12e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 583.97  on 53  degrees of freedom
## Residual deviance: 564.56  on 52  degrees of freedom
## AIC: 871.7
##
## Number of Fisher Scoring iterations: 4
```

# summary(m3\_gen)

```
##
## Call:
## glm(formula = gestures ~ 1 + gender, family = poisson(link = "log"),
##      data = df)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -6.7432  -2.7667  -0.2118   1.9619   6.2463
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   3.88083    0.02715 142.961  <2e-16 ***
## genderM       0.04115    0.03871   1.063   0.288
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 583.97  on 53  degrees of freedom
## Residual deviance: 582.84  on 52  degrees of freedom
## AIC: 889.98
##
## Number of Fisher Scoring iterations: 4
```

# Model 4: 3 predictors

```
m4_all <- glm(formula = gestures ~ 1 + gender + context + language,
              data     = df,
              family    = poisson(link = 'log')
              )
coef(m4_all)
```

##	(Intercept)	genderM	contextprof	languageKorean
##	4.04690799	0.03464544	-0.17724157	-0.16997795

# Model 4: 3 predictors

```
##
## Call:
## glm(formula = gestures ~ 1 + gender + context + language, family = poisson,
##      data = df)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -6.1975  -2.7275  -0.0876   2.2215   5.4705
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    4.04691    0.03701  109.355  < 2e-16 ***
## genderM         0.03465    0.03874   0.894    0.371
## contextprof    -0.17724    0.03886  -4.561 5.08e-06 ***
## languageKorean -0.16998    0.03903  -4.356 1.33e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 583.97  on 53  degrees of freedom
## Residual deviance: 542.87  on 50  degrees of freedom
## AIC: 854.01
```



# Model 4: 2 predictors

```
m5_gairabe_tots <- glm(formula = gestures ~ 1 + context + language,
                        data     = df,
                        family   = poisson(link = 'log'))
coef(m5_gairabe_tots)
```

```
##      (Intercept)      contextprof languageKorean
##      4.0643807      -0.1772416      -0.1713112
```

# Modelo 4: 2 predictores

```
##
## Call:
## glm(formula = gestures ~ 1 + context + language, family = poisson(link =
##      data = df)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -6.0963  -2.7462   0.0327   2.2950   5.3442
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    4.06438    0.03132 129.749  < 2e-16 ***
## contextprof   -0.17724    0.03886  -4.561 5.08e-06 ***
## languageKorean -0.17131    0.03900  -4.393 1.12e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 583.97  on 53  degrees of freedom
## Residual deviance: 543.67  on 51  degrees of freedom
## AIC: 852.81
##
```

# AICs

```
m1_context$aic
```

```
## [1] 870.2175
```

```
m2_lleng$aic
```

```
## [1] 871.6956
```

```
m3_gen$aic
```

```
## [1] 889.9752
```

```
m4_all$aic
```

```
## [1] 854.0088
```

```
m5_gairabe_tots$aic
```

```
## [1] 852.8084
```

# Propera sessió

- Lliurament de Assignment 5 (08:00 AM 23/05)
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- **Models lineals generalitzats II**