# Introduction to environmental time-series analysis

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XIV Summer School UPC-FME

Barcelona, 2021/06/29

# Additional materials

- Risk ratio and Poisson regression
- Splines

# Risk ratio

- **Counts**

| | *Outcome (y)* | |
|---|---|---|
| | *Yes* | *Pop.* |
| *Exposed (x=1)* | $d_1$ | N |
| *Non-exposed (x=0)* | $d_0$ | N |

$$RR = (d_1/N) / (d_0/N) =$$
$$= d_1 / d_0$$

- **Rates**

| | *Outcome (y)* | |
|---|---|---|
| | *Yes* | *Pop.* |
| *Exposed (x=1)* | $d_1$ | $N_1$ |
| *Non-exposed (x=0)* | $d_0$ | $N_0$ |

$$RR = (d_1/N_1) / (d_0/N_0)$$

# Poisson regression

- **Counts**

$\mathbf{log(\mu_i) = \alpha + \beta x_i}$

*i = (0, 1)*

if *x=0* then $\mu_0$ = $\mathbf{exp(\alpha)}$

it *x=1* then $\mu_1$ = $\mathbf{exp(\alpha+\beta)}$

therefore $\mathbf{exp(\beta)} = \mu_1 / \mu_0$

- **Rates**

$\mathbf{log(\mu_i/N_i) = \alpha + \beta x_i}$

$\mathbf{log(\mu_i) = \alpha + \beta x_i + log(N_i)}$

*i = (0, 1)*

if *x=0* then $\mu_0/N_0$ = $\mathbf{exp(\alpha)}$

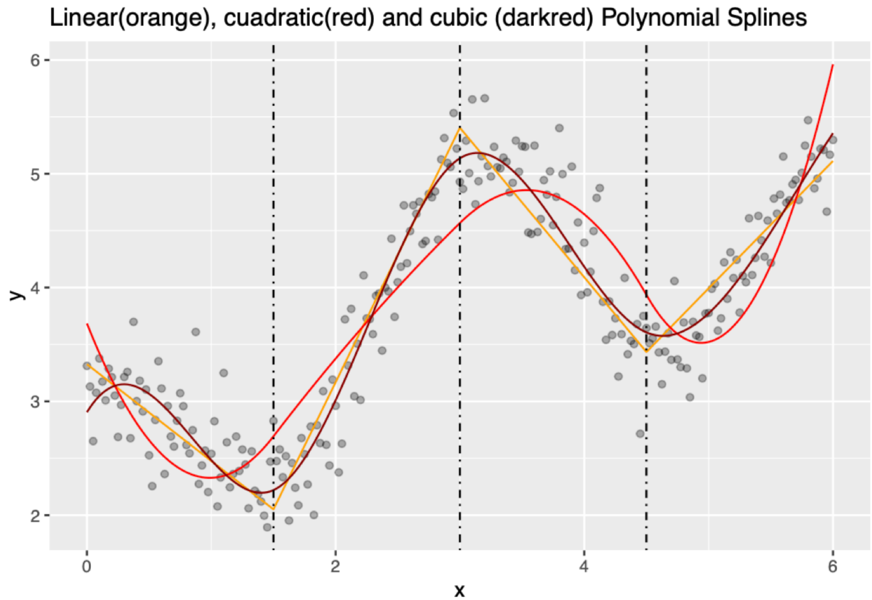
if *x=1* then $\mu_1/N_1$ = $\mathbf{exp(\alpha+\beta)}$

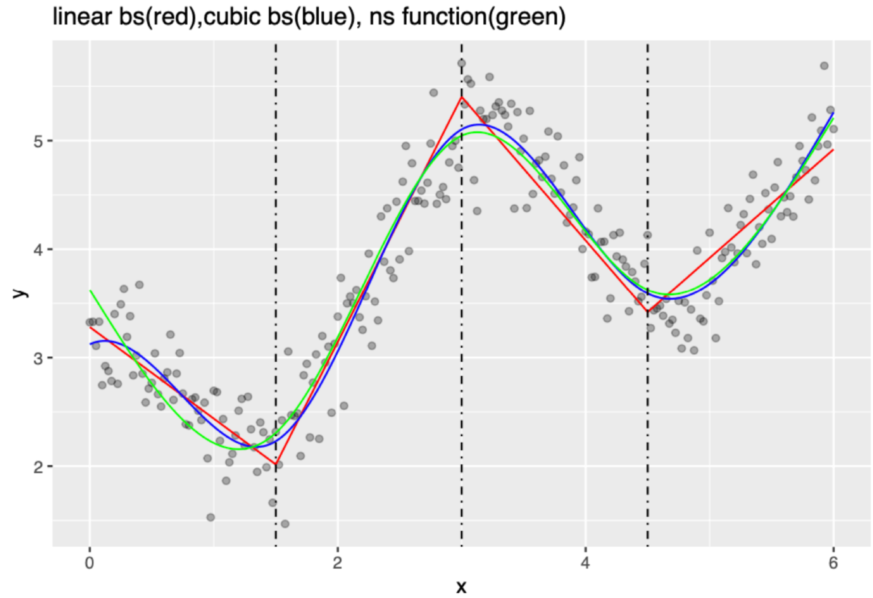
therefores $\mathbf{exp(\beta)} = (\mu_1/N_1) / (\mu_0/N_0)$

# Splines

- **Polynomial splines**
  - Fit a set of piecewise regressions with the only restriction being that they intersect at the knots (lineal, quadratic, cubic)
  - In general as higher is the degree as better is the fit, because more flexibility is allowed for
- **B-splines**
  - Reparameterization of polynomial splines to avoid computational problems from high order truncated polynomial splines
- **Natural cubic splines**
  - Reduce the uncertainty by imposing linearity in the tails beyond the boundary knots

# Splines


Linear(orange), cuadratic(red) and cubic (darkred) Polynomial Splines
y
x
0
2
4
6
2
3
4
5
6


linear bs(red),cubic bs(blue), ns function(green)
y
x
0
2
4
6
2
3
4
5