- generalized linear models GLM

GLIM

(par)

- generalized additive models

GAM

(semi par)

- generalized est'g eqn GEE (s-p)

- generalized linear mixed models

GLMM

I. Principles of App Stat Cox & D.

II. Davison - Stat Models

Ch 9 Designed Exp

III. ← case studies / examples 10 GLM etc.

\+ other refs

GLM GAM ~~GEE~~ GLMM

Ch 9 – 9.3 next week

Now some more stuff too small

point one

- point 2

- if covariate measured after randomization, or randomization fails, you can adjust for it using analysis of covariance

model: response

= treat + covariate eff.

+ error

(§9.3)

Model

$$y_j = \mu + \delta + \varepsilon_j \quad \text{tmt}$$
$$\mu - \delta + \varepsilon_j \quad \text{control}$$

Std lin model

Rand$^{\underline{n}}$: $\exists\ \gamma_j \quad j = 1, \dots, n$ s.t. $Y_j = \gamma_j + \delta$

under tmt,

$Y_j = \gamma_j - \delta$, under cont

$j = 1, \dots, 2m = n$

$$Y_j = T_j(\gamma_j + \delta), \quad T_j = 1$$
$$= (1 - T_j)(\gamma_j - \delta), \quad T_j = 0$$

$$T_j = \begin{matrix} 1 & \text{wp } \frac{1}{2} \\ 0 & \text{wp } \frac{1}{2} \end{matrix}$$

$$t = (\bar{Y}_1 - \bar{Y}_0) / \sqrt{\tilde{\sigma}^2}$$

$\leftarrow$ t under

$$E_R T_j = \frac{1}{2} \quad E T_j T_k = \frac{m-1}{2(2m-1)}, j \neq k$$

$$E_R\left(\frac{2s^2}{m}\right) =$$

$$E_R(\bar{Y}_1 - \bar{Y}_0) = 2\delta$$
$$\text{var}_R(\bar{Y}_1 - \bar{Y}_0) = 2 \sum (\gamma_j - \bar{\gamma})^2 / m(2m-1)$$

Applied in D to 1-sample paired test

Can be used much more generally

Cox & Reid (D of E), Kempthorne & H

But, $\gamma_j \pm \delta$, unit-tmt additivity,
indep. of tmt alloc to other units

More gen'lly $y_j = \gamma_j + \alpha_i$, if tmt i

assigned to unit j

not testable by data

Strengthens case for causality

- physical: "if $x \uparrow$, $y \uparrow$ by factor of b_0 Hooke's law

- observational - the effect of x on y can't be explained by dependence on other allowable variables

- expt'l: "we used rand$^=$ & a unit-tmt add. ass^n & this ensures sample mean is unbiased est of the true mean diff.

"Counterfactual" concluding caus.. in obs'l studies

Bradford Hill's guidelines for causality

(i)

§9.2 - one-way layout / CRD / 1-way anova

- k-group comparison

$y_{tr} = \beta_t + \varepsilon_{tr}$, $\varepsilon_{tr} \sim (0, \sigma^2)$, $t = 1, \dots, T$
$r = 1, \dots, R$

$\overset{OR}{=} \mu + \alpha_t + \varepsilon_{tr}$ (over-param'd)

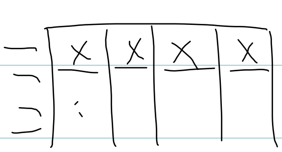
$n = TR$

(ii) - 2 way layout/anova, RB design

$y_{tr} = \mu + \alpha_t + \beta_r + \varepsilon_{tr}$ $t = 1, \dots, T$; $r = 1, \dots, R$

$n = TR$

	SS	
tmt	38.7	5
blk	15.2	4
err	3.7	?



incomplete block design - can't have each trmt

in each blk - no room; no time; or ...

- lose orthogonality - we don't know if

trmt diff due only to trmt, or something else

Ex 9.4 - 6 trmts; 2 units / block

1: C T_1
2: C T_2
3: C T_3 } balance
⋮

T_1 T_2
T_2 ⋮ T_3

analysis is less straightforward

- Latin square
- factorial designs (factorial tmt str)

Each tmt is composed of 2 or more factors each at 2 or more levels

Ex 9.6 3×4 2 tmts 3 levels A
4 levels B

$i = 1, \ldots, 3$

12 combinations (tmts)

	1	2	3	4
1	x x x y_{11i}	x x x y_{12i}	x x x	
2				
3				

2 blocking factors

1 tmt factor

each have q levels

(I Block Design)

$q = 4$

$$
\begin{array}{c|cccc}
 & & & B_2 & \\
\hline
 & \boxed{A \quad B \quad C \quad D} & & & \\
B_1 & B & C & D & A \\
\downarrow & C & D & A & B \\
 & D & A & B & C
\end{array}
$$

4

LS

576

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$B\gamma$ $D\alpha$ $C\beta$ $A\delta$

$C\delta$ $A\beta$ $B\alpha$ $D\gamma$

$A\alpha$ $C\gamma$ $D\delta$ $B\beta$

$D\beta$ $B\delta$ $A\gamma$ $C\alpha$

Graeco-L sq.

pair of $\perp$ (orthog)

LS size 4

no GL sq size 6

? 10 ?

1730 $n \equiv 2 \bmod 4$

$\nexists$ GL squares

X

1960 10 x 10 pair of $\perp$ L.S.