Population Psychometrics

Geographical, temporal and demographic structure

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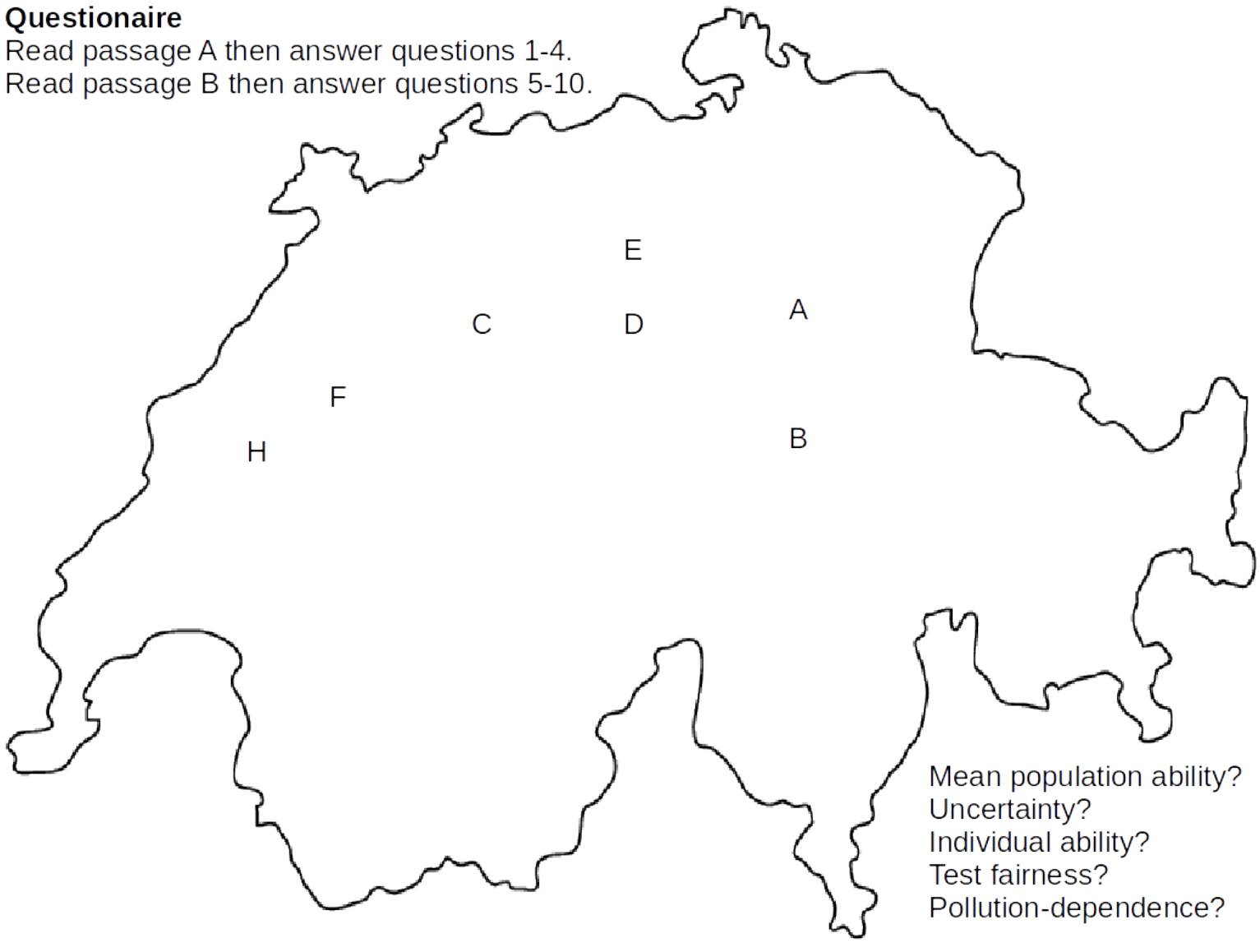
Population psychometrics



Population psychometrics

$$
\begin{aligned}
Y_{ijs} &= I(Y^*_{ijs} > 0) \\
Y^*_{ijs} &= \beta_{0js} + \beta_{ijs} + \epsilon_{ijs} \\
\beta_{0js} &= \lambda_{00} + U_{0js} \\
\beta_{ijs} &= \lambda_{i0} \\
U_{0js} &= V_s + S_j
\end{aligned}
$$

- Stein
- Krige
- Simpson
- Pearl
- Fisher

Identifiability constraints, ϵ_{ijs} iid logistic (no LD)
$\beta_{ijs} = \lambda_{i0}$ (no random or fixed DIF)

Population psychometrics

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MMSE and regularization
Between-subject variablity in DIF.

Population psychometrics

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\beta_{0js} &= \lambda_{00} + U_{0js} \\
\beta_{ijs} &= \lambda_{i0} + W_{ijs} \\
\mathrm{U}_{0js} &= V(s_j) + S_j
\end{aligned}
$$

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$V(s) \sim Process(\mu, C)$.
Item recommendation.

Population psychometrics

$$
\begin{aligned}
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\mathrm{Y}^*_{ijs} &= \beta_{0js} + \beta_{ijs} + \epsilon_{ijs} \\
\beta_{0js} &= \lambda_{00} + \lambda_{01} X_{js} + U_{0js} \\
\beta_{ijs} &= \lambda_{i0} \\
\mathrm{U}_{0js} &= V_k + S_j
\end{aligned}
$$

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"Exogeneity" LD: $U_{0js} \perp\!\!\!\perp X_{js}$, $X_{js} \neq f(V_k)$.
Graphical identifiability criterea/stratified randomization.

Conclusion: Dependence misspecification

- Over-fit λ (underestimated s.e. via local dependence within testlet, subject, region), but applies to spatial/temporal dependence too!
- Biased λ (Simpson)
- Overfit β (relative to MMSE James-Stein)
- Forgo β prediction/generalization!

Population psychometrics: Dependence mis-specification

- Questions