Disadoption Contagion: Conceptual Framing and Methods

(compiled for the KFP project)

Overview

This note formalizes "disadoption contagion" for the Korean Family Planning (KFP) data and outlines estimands and models that leverage the general time–by–state information encoded in `TOA_derivado_general`. The aim is to (i) clarify concepts and operational definitions for adoption vs. disadoption, (ii) collapse 21 detailed states to three meta-states when needed, and (iii) propose regression designs—event–history for *stable* disadoption and panel/transition models for *temporary* disadoption—. Conceptual scaffolding follows my document (see §4.3 and Eq. (7))

1 Introduction

1.1 Adoption vs. Disadoption in the classical framework

Classical diffusion treats adoption as a one–off, irreversible event per ego ("time of adoption", TOA). In real usage data, contraceptive behavior fluctuates: egos can move from a modern method to traditional/no use and later revert. Thus, while the *adoption* construct is convenient for event–history modeling, observed trajectories reveal multiple episodes of adopting and disadopting across time.

1.2 What is observed in `TOA_derivado_general`

With the period–by–ego status matrix (1047×11) and complete state labels (21 categories), heatmaps and random trajectories show frequent switching. This richer object validates the standard TOA reconstruction (so it is *consistent* with Valente's prior work, see Table 10-2 from Valente's 2010 book) while enabling analyses beyond a single adoption event: repeated adoptions, disadoptions, and state sojourns.

1.3 Collapsing to three meta–states

For interpretability and to focus on behavioral macro–shifts, I collapse states to:

$$\begin{aligned} \mathsf{Modern} &= \{\text{Loop, Pill, Condom, Vasectomy, TL, Injection}\} \\ \mathsf{Traditional} &= \{\text{Rhythm, Withdrawal, etc.}\} \\ \mathsf{NoUse} &= \{\text{NormalB, Want More, No more, Pregnant, Infertile, Abortion, ...}\}. \end{aligned}$$

This yields a categorical process $S_{it} \in \{\mathsf{Modern}, \mathsf{Traditional}, \mathsf{NoUse}\}$ for ego i at period t.

1.4 Disadoption as recurrent events

Under this view, *disadoption* is any transition leaving Modern:

$$\mathsf{Modern} \to \mathsf{Traditional} \quad \text{or} \quad \mathsf{Modern} \to \mathsf{NoUse}.$$

These transitions can be *recurrent*: the same ego can disadopt, then re–adopt, multiple times.

1.5 Exposure to disadoption

Mirroring adoption exposure, I define disadoption exposure as the local prevalence of alters who have *left* modern use. A convenient construction (Eq. (7) in my document) uses the gap between the *maximum adoption exposure* attained and the current adoption exposure at t:

$$E_i^D(t) \;=\; E_i^{\max} - E_i(t),$$

where $E_i(t)$ is the standard cohesion exposure to *current* modern users among i's alters, and $E_i^{\max} := \max_{u\le t} E_i(u)$. Intuitively, when many neighbors who *used to* be modern stop being modern, $E_i(t)$ falls below its past peak and $E_i^D(t)$ grows.

1.6 Temporary vs. Stable disadoption

- **Temporary disadoption**: any period with $S_{it} \neq \mathsf{Modern}$ after being modern earlier, regardless of eventual return.
- **Stable disadoption**: the *last* exit from Modern followed by no return up to the observation horizon; formally, the terminal transition $\mathsf{Modern} \to \{\mathsf{Traditional}, \mathsf{NoUse}\}$ with no subsequent Modern.

1.7 Implications for modeling

- For **stable** disadoption, an event–history (survival / discrete–time hazard) design aligns with the single "terminal" event per ego.
- For **temporary** disadoption, a panel transition model (multinomial or binary flows per period) captures repeated moves with time–varying exposures.

2 Methods

2.1 Notation and inputs from `TOA_derivado_general`

Let $\mathcal{N}_i$ be i's alters (per period), $A_{ij}(t) \in \{0,1\}$ the adjacency matrix, and $M_j(t) = \mathbf{1}\{S_{jt} = \mathsf{Modern}\}$, that is, if j has adopted a modern method. Define the (cohesion) adoption exposure for ego i at t:

$$E_i(t) \;=\; \frac{\sum_{j\in\mathcal{N}_i} A_{ij}(t)\, M_j(t-1)}{\sum_{j\in\mathcal{N}_i} A_{ij}(t)} \quad \text{(lagged by one period).}$$

Then $E_i^{\max}(t) = \max_{u\le t} E_i(u)$ and the *disadoption exposure*

$$E_i^D(t) = E_i^{\max}(t) - E_i(t) \in [0,1].$$

Optionally incorporate homophily/SE weighting, or village–level terms (e.g., cumulative disadoptions in the village at t) as additional covariates.

2.2 Stable disadoption: discrete-time event history

Define the at–risk set $\mathcal{R}_t = \{i : S_{i,t-1} = \textsf{Modern}\}$ and event indicator $Y_{it} = \mathbf{1}\{S_{i,t} \neq \textsf{Modern}\}$, *restricted to the last exit* from Modern (one terminal event per ego). The logit hazard:

$$\begin{aligned}\text{logit}\ \Pr\{Y_{it} = 1 \mid \mathcal{F}_{t-1}\} = \alpha_t + \beta_D E_i^D(t) + \beta_E E_i(t) + \gamma_{\text{deg}}^\top \mathbf{d}_i(t) \\ + \gamma_{\text{med}}\, \text{media}_i + \gamma_{\text{kids}}\, \text{children}_i + \delta_g\, \text{CumDisadopt}_{g(i)}(t) + \varepsilon_i,\end{aligned}$$

where $\mathcal{F}_{t-1}$ is the information set available up to time $t-1$, α_t is a period effect (or linear trend t), $\mathbf{d}_i(t) = \{\text{deg}_{\text{in}}, \text{deg}_{\text{out}}\}$, and $\text{CumDisadopt}_{g(i)}(t)$ is the village–level cumulative number (or share) of disadopters up to t. Interpretation:

- $\beta_D > 0$ implies that larger falls from past peak adoption exposure among i's neighbors (i.e., more neighbors who *used to* be modern and no longer are) increase i's terminal disadoption hazard.
- $\beta_E < 0$ (often) reflects protection against disadoption when current neighbor modern use is high.

This mirrors adoption models (Valente 2010) but reverses the risk set and uses $E_i^D(t)$ as the social signal of disadoption pressure.

2.3 Temporary disadoption: panel/transition designs

Because egos can leave and re–enter Modern repeatedly, period–by–period transitions can be used. Two practical options:

(T1) Binary flow from Modern. Among i with $S_{i,t-1} = \textsf{Modern}$, model

$$\text{logit}\ \Pr\{S_{it} \neq \textsf{Modern}\} = \alpha_t + \beta_D E_i^D(t) + \beta_E E_i(t) + \gamma^\top \mathbf{X}_i(t),$$

with $\mathbf{X}_i(t)$ as above. This estimates *any* exit from Modern (temporary or stable). Clustered SEs by ego or random effects can account for repeated observations.

(T2) Multinomial three–way flow. For all i,

$$\Pr\{S_{it} = s \mid S_{i,t-1}\} = \text{softmax}_s\Big(\alpha_{s,t} + \beta_{D,s} E_i^D(t) + \beta_{E,s} E_i(t) + \gamma_s^\top \mathbf{X}_i(t)\Big), \quad s \in \{\textsf{Modern}, \textsf{Traditional}, \textsf{NoUse}\}.$$

This distinguishes Modern → Traditional vs. Modern → NoUse and can quantify possibly different social signals behind each pathway (e.g., method substitution vs. cessation).

2.4 Constructing E^D in practice

To construct the disadoption exposure E^D, I need to:

1. Build $M_j(t)$ from the collapsed meta–states in `TOA_derivado_general`.
2. Compute $E_i(t)$ with period–$t-1$ neighbor states and the relevant adjacency (cohesion; optionally SE–weighted).
3. Track $E_i^{\max}(t)$ and form $E_i^D(t) = E_i^{\max}(t) - E_i(t)$.
4. Optionally normalize by degree or smooth via moving maxima to reduce noise in short runs.

2.5 Controls and identification notes

- Period dynamics: use α_t (FE) or a parametric trend (t, t^2). The FE absorbs common shocks (program intensity, information waves).
- Village context: include village FE and/or village–level cumulative disadoption to net out local saturation.
- Degrees & media/children: mirror the adoption models so comparisons are on like–for–like covariate sets.
- Repeated observations: cluster by ego; for multinomial/panel logit, use random effects or GEE for robustness.
- Interpretation: β_D captures *social signal of leaving* modern methods; β_E captures contemporaneous *anchor to stay.*

3 Intuition and reading the coefficients

Why E^D works. When many of your alters who *had* been modern switch away, your current adoption exposure drops below what you previously experienced. That gap is a direct signal that "people like me are leaving," which can create social permission or pressure to disadopt. Conversely, a high $E_i(t)$ anchors continued use by indicating strong modern adherence now.

4 Reporting

- For stable disadoption, odds ratios (or discrete-time hazards) for E^D and E with period/village FE and the usual covariates can be reported.
- For temporary disadoption, transition probability matrices by period, and marginal effects from (T1)/(T2) can be provided.
- Contrasts with adoption models to show asymmetries (e.g., $|\beta_D|$ vs. $|\beta_E|$) can be made.