Spreading of depressive symptoms over adolescent friendship networks.

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Background
- Depression affects 350 million people worldwide\(^1\).
- It is characterised by a set of symptoms which could be affected by social networks.
- We explore this possibility using a range of statistical methods.

Data
- National Longitudinal Study of Adolescent Health (Add Health) - health behaviours of United States adolescents in 1994-95 and 1996\(^2\).
- Includes friendship data - friendship network.
- Includes Centre for Epidemiological Studies Depression (CES-D) scale questions - quantised depression score\(^3\).

Empirical Data Analysis

Figure 1: (i) and (ii) - grid plots of CES-D scores at the first time point (wave I) against the second time point (wave II). (i) - coloured by worse off friends. (ii) - coloured by better off friends. (iii) - Empirical distribution of CES-D score change.
- Empirical data shows an effect from higher and lower scoring friends on the change in CES-D score.
- The score changes appear to follow an exponential distribution.

Figure 2: Results for Helplessness. Red - model 1. Blue - model 2. Green - model 3. Purple - model 4. Black - observed frequencies. (i) and (ii) depend on worse off friends; (iii) and (iv) on better off friends. Model 1 is preferred for all symptoms except poor appetite.

Parametric Inference
- Considered total CES-D score and 7 component symptoms - anhedonia, poor appetite, poor concentration, dysphoria, helplessness, tiredness, and worthlessness.
- Worsening: \(X_i > X_{i-1}, X_{i-1} > Y_{i-1}, i = 1, \ldots, k\)
- Improving: \(X_i < X_{i-1}, X_{i-1} < Y_{i-1}, i = 1, \ldots, k\)

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\begin{align*}
Y_k &= \alpha + \beta \sum_{i=0}^{k-1} \left( t_i \right)^\gamma 
Y_i = Y_k - Y_i, \quad \text{for } i < k \\
p_k &= \frac{q_k}{p_k} = \frac{\gamma + \delta}{\delta} \left( 1 + \frac{\gamma \alpha}{\delta} \right)^{m-1} \\
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\end{align*}
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- Model 1 - (a) and (i). Model 2 - (b) and (d). Model 3 - (a) and (d).
- Model 4 - (b) and (c).
- Model parameters - inferred from data using maximum likelihood estimation.
- Models were compared using their Akaike Information Criterion.

Parametric Inference - Poor Appetite

Figure 3: Results for Poor Appetite dependent on worse off friends. Model to line correspondence is the same as figure 2. Unlike with all other symptoms, model 4 is preferred.

Conclusions
- For most symptoms, the emotional state of friends can have both a positive or negative effect on the state of an individual.
- This effect only occurs for smaller numbers of friends.
- These symptoms reflect the total CES-D score.
- Appetite is the only symptom to not follow this pattern.
- Empirical findings suggest that the change in symptoms occurs progressively between time points - more testing is needed.

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References: