

Application to Depressive and Anxiety disorders

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This is a document describing the MLD model and a MM algorithm.

Introduction

Depression and anxiety disorders are common at all ages. Approximately one out of three people in the Netherlands will be faced with them at some time during their lives. It is still not clear why some people recover quickly and why others suffer for long periods of time. The Netherlands Study of Depression and Anxiety (NESDA) was therefore designed to investigate the course of depression and anxiety disorders over a period of several years. For more information about the study design see Penninx et. al. (2008?). In our application we will analyse data from the first wave focussing on the relationship between personality and depressive and anxiety disorders. The data have been analysed previously by Spinhoven et. al. (2009). Data was collected from three different populations: from primary health care, from generalised mental health care, and from the general population. Our analysis will focus on the population of generalised health care.

We have data for 786 participants. The diagnoses of depressive (Dysthymia (D), Major Depressive Disorder (MDD)) and anxiety disorders [Generalized Anxiety Disorder (GAD), Social Phobia (SP), and Panic disorder (PD)] were established with the Composite Interview Diagnostic Instrument (CIDI) psychiatric interview. Personality was operationalized using the 60-item NEO Five-Factor Inventory (NEO-FFI). The NEO-FFI questionnaire measures the following five personality domains: Neuroticism, Extraversion, Agreeableness, Conscientiousness and Openness to Experience. Besides these five predictors three background variables were measured: age, gender, and education in years.

Because off the high comorbidity among disorders, psychiatrist developed three different theories:

1. an unidimensional structure where all the disorders are represented by a single dimension.
2. a 2-dimensional structure with one dimension representing distress (D, MDD, GAD) and the other one fear (SP, PD);
3. a 2-dimensional structure with one dimension representing depression (D, MDD) and the other one anxiety (GAD, SP, PD);

Obviously, we can define another two dimensional structure (theory 4) were the dysthymia and major depressive disorders pertain to the first dimension, social phobia and panic disorder to the second, and generalized anxiety disorder to both dimensions.

Analysis

The data set has 786 participants. The prevalences in the data are 21.25% for dysthymia, 76.21% for major depressive disorder, 30.41% for generalized anxiety disorder, 41.6% for social phobia, and 52.8% for panic disorder. Of the 786 participants 272 have a single disorder, the others all have multiple disorders. There are 235 participants with two disorders, 147 with three, 96 with four, and 36 participants with 5 disorders.

As explained above there are four different theories about the comorbidity of the depressive and anxiety disorders. One concludes that there is one underlying continuum while the three others group the disorders in two underlying dimensions. Each of these three two dimensional theories gives rise to a different response variable by dimension

indicator matrix:

$$\mathbf{D}_1 = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}, \mathbf{D}_2 = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}, \mathbf{D}_3 = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 1 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}.$$

Let us analyse the data based on these four theories.

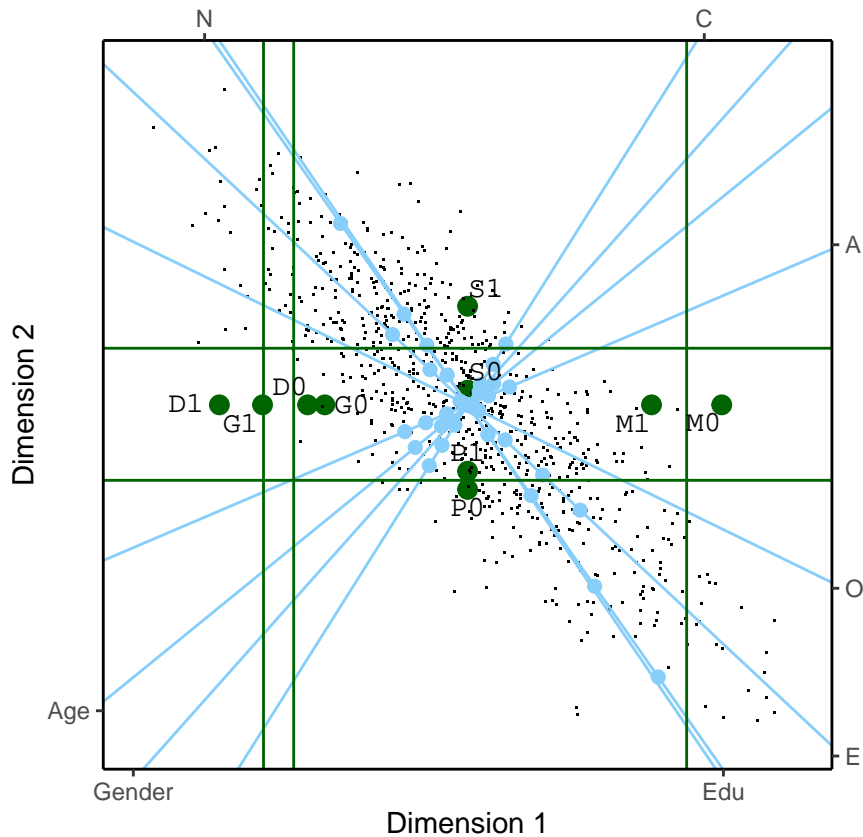
AIC

| ## | Model | Deviance | #param | AIC | BIC |
|---------|-------|----------|--------|----------|----------|
| ## [1,] | 1 | 4553.335 | 17 | 4587.335 | 4666.673 |
| ## [2,] | 2 | 4531.171 | 24 | 4579.171 | 4691.178 |
| ## [3,] | 3 | 4533.712 | 24 | 4581.712 | 4693.719 |
| ## [4,] | 4 | 4530.352 | 25 | 4580.352 | 4697.026 |

We can see that all four theories give about the same fit, where the distress-fear hypothesis has a slightly lower AIC value than the other theories. The resulting graphical display for this model is given in the following plot. We can see that three response variables pertain to the horizontal dimension, while two pertain to the vertical dimension. We can see that on the horizontal dimension dysthymia is best discriminated, the two points lie farthest apart (distance 0.80), while the distance for major depressive disorder is 0.64, and generalized anxiety disorder 0.56. On the vertical axis social phobia is well discriminated (distance 0.76) while panic disorder is hardly discriminated (distance 0.16). The latter means that using the three background variables and the five personality variables we have hardly any information to distinguish participants with and without panic disorder.

```
p = plot.mldm(out2)
p
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```



```
ggsave(filename = "~/surfdrive/MLDM/mldm2/Figures/nesda_mldm.pdf", plot = p, width = 11.5,
height = 8.3, units = "in", limitsize = FALSE)
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```

```
out2$LRcoef
```

```
##           D           M           G           S           P
## Gender  0.08381046  0.06669555  0.05912833 -0.08955553 -0.019410217
## Age     0.18932352  0.15066183  0.13356787 -0.14682177 -0.031822071
```

```
## Edu      -0.14720908 -0.11714756 -0.10385610 -0.20553055 -0.044546580
## N         0.46009141  0.36613631  0.32459480  0.62485791  0.135431361
## E        -0.27172007 -0.21623221 -0.19169870 -0.24189361 -0.052427890
## O        -0.02703573 -0.02151478 -0.01907373 -0.01254851 -0.002719758
## A        -0.15143616 -0.12051143 -0.10683831  0.06157478  0.013345685
## C        -0.09250876 -0.07361758 -0.06526499  0.13964652  0.030266911
```

```
mldm.diag(out2)
```

```
##          [,1]
## D 0.9835700
## M 0.8957461
## G 0.8453176
## S 0.9851616
## P 0.1705534
```

Here we see that the response variable panic disorder is badly represented in this model.

unconstrained 2d model

```
out5 = mldm1(X, Y, M = 2)
```

Fit statistics

```
out5$QD
```

```
## [1] 4521.814
```

```
out5$npars
```

```
## [1] 28
```

```
out5$QD + 2 * out5$npars
```

```
## [1] 4577.814
```

```
out5$QD + log(N) * out5$npars
```

```
## [1] 4708.488
```

Diagnostics

```
mldm.diag(out5)
```

```
##           [,1]
```

```
## D 0.9676373
```

```
## M 0.8800506
```

```
## G 0.8453936
```

```
## S 0.8636872
```

```
## P 0.8980367
```

```
p = plot.mldm(out5)
```

```
ggsave(filename = "~/surfdrive/MLDM/mldm2/Figures/nesda_mldm2.pdf", plot = p, width = 11,  
        height = 8.3, units = "in", limitsize = FALSE)
```

```
## Warning in min(x): no non-missing arguments to min; returning Inf
```

```
## Warning in max(x): no non-missing arguments to max; returning -Inf
```

```
## Warning in min(x): no non-missing arguments to min; returning Inf
```

```
## Warning in max(x): no non-missing arguments to max; returning -Inf
```

```
## Warning: Removed 2 rows containing missing values (geom_point).
```

Suggests a new theory with MDD, Dyst, GAD, SP on one dimension and PD on another.