Appendix I – Model adaptation workflow

This appendix contains all the ICC parameter estimates for model adaptation based on baseline data from study 168 and study 169:

1 **Intellectual Impairment in UPDRS: Cognitive Impairment in MDS-UPDRS:**

Indirect mapping mechanism: UPDRS $\rightarrow$ MDS-UPDRS

$0 \rightarrow 0, 1 \rightarrow 2, 2 \rightarrow 3, 3 \rightarrow 4, 4 \rightarrow 4$

\[
\begin{align*}
P(Y_{ij} = 0) &= P0 + P1*FR1 \\
P(Y_{ij} = 1) &= P2 + P1*(1 - FR1) \\
P(Y_{ij} = 2) &= P3 \\
P(Y_{ij} = 3) &= P4*FR4 \\
P(Y_{ij} = 4) &= P4*(1 - FR4)
\end{align*}
\]

<table>
<thead>
<tr>
<th>Item $-j$</th>
<th>Category</th>
<th>$a_j$</th>
<th>$b_{j,k}$</th>
<th>FR</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>&gt; 3</td>
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<td></td>
</tr>
<tr>
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<td>= 4</td>
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<td>57</td>
<td></td>
</tr>
</tbody>
</table>

2 **Thought Disorder in UPDRS: Hallucinations and Psychosis in MDS-UPDRS**

Indirect mapping mechanism: UPDRS $\rightarrow$ MDS-UPDRS

$0 \rightarrow 0, 1 \rightarrow 0, 2 \rightarrow 1|2, 3 \rightarrow 3, 4 \rightarrow 4$

\[
\begin{align*}
P(Y_{ij} = 0) &= P0*FR0 \\
P(Y_{ij} = 1) &= P0*(1 - FR0) \\
P(Y_{ij} = 2) &= P1 + P2 \\
P(Y_{ij} = 3) &= P3 \\
P(Y_{ij} = 4) &= P4
\end{align*}
\]

<table>
<thead>
<tr>
<th>Item $-j$</th>
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<td>2</td>
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<td>$FR0 = 0.84$</td>
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<td>&gt; 2</td>
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### 3 Depression in UPDRS: Depressed mood in MDS-UPDRS

Direct mapping

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<td>&gt; 2</td>
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<td>&gt; 3</td>
<td>6.2</td>
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<td>= 4</td>
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<tr>
<td></td>
<td></td>
<td>0.76</td>
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</table>

### 4 Motivation and Initiative in UPDRS: Apathy in MDS – UPDRS

Direct mapping

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<th>$b_{j,k}$</th>
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<td>&gt; 3</td>
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<td>= 4</td>
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<td>1.1</td>
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### 5 Speech in UPDRS: Speech in MDS-UPDRS

Direct Mapping

<table>
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<th>$b_{j,k}$</th>
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<td></td>
<td>&gt; 2</td>
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<td></td>
<td>&gt; 3</td>
<td>4.2</td>
<td></td>
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<td></td>
<td>= 4</td>
<td>54</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>1.1</td>
<td></td>
</tr>
</tbody>
</table>
6 Salivation in UPDRS: Saliva and Drooling in MDS-UPDRS

Indirect mapping mechanism: UPDRS \( \rightarrow \) MDS-UPDRS

\[
\begin{align*}
P(Y_{ij} = 0) &= P0 + P1*FR1 \\
P(Y_{ij} = 1) &= P1*(1 - FR1) + P2 \\
P(Y_{ij} = 2) &= P3*FR3 \\
P(Y_{ij} = 3) &= P3*(1 - FR3) \\
P(Y_{ij} = 4) &= P4
\end{align*}
\]

<table>
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<tr>
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<th>( b_{j,k} )</th>
<th>( FR )</th>
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<tbody>
<tr>
<td>6</td>
<td>&gt; 1</td>
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<td>0.70</td>
<td>( FR1 = 1 )</td>
</tr>
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<td></td>
<td>&gt; 2</td>
<td>1.0</td>
<td>1.7</td>
<td>( FR3 = 0.76 )</td>
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<tr>
<td></td>
<td>&gt; 3</td>
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<td>3.0</td>
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<tr>
<td></td>
<td>= 4</td>
<td></td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

7 Swallowing in UPDRS: Chewing and Swallowing in MDS-UPDRS

Indirect mapping mechanism: UPDRS \( \rightarrow \) MDS-UPDRS

\[
\begin{align*}
P(Y_{ij} = 0) &= P0 + P1*FR1 \\
P(Y_{ij} = 1) &= P1*(1 - FR1) + P3*FR3 \\
P(Y_{ij} = 2) &= P3*(1 - FR3) \\
P(Y_{ij} = 3) &= P2 \\
P(Y_{ij} = 4) &= P4
\end{align*}
\]

<table>
<thead>
<tr>
<th>Item -j</th>
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<th>( b_{j,k} )</th>
<th>( FR )</th>
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<td>7</td>
<td>&gt; 1</td>
<td></td>
<td>1.9</td>
<td>( FR1 = 0.57 )</td>
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<td></td>
<td>&gt; 2</td>
<td>1.0</td>
<td>4.8</td>
<td>( FR3 = 0 )</td>
</tr>
<tr>
<td></td>
<td>&gt; 3</td>
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</tr>
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<td></td>
<td>= 4</td>
<td></td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>
8 Handwriting in UPDRS: Handwriting in MDS-UPDRS

Indirect mapping mechanism: UPDRS \(\rightarrow\) MDS-UPDRS

\(0 \rightarrow 0, 1 \rightarrow 1, 2 \rightarrow 1, 3 \rightarrow 2 \mid 3, 4 \rightarrow 4\)

\[
P(Y_{ij} = 0) = P0 \\
P(Y_{ij} = 1) = P1 \cdot FR1 \\
P(Y_{ij} = 2) = P1 \cdot (1 - FR1) \\
P(Y_{ij} = 3) = P2 + P3 \\
P(Y_{ij} = 4) = P4
\]

<table>
<thead>
<tr>
<th>Item (-j)</th>
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<th>(b_{j,k})</th>
<th>(FR)</th>
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<td>&gt; 2</td>
<td>0.90</td>
<td>1.5</td>
<td></td>
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<td></td>
<td>&gt; 3</td>
<td></td>
<td>3.4</td>
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<td>= 4</td>
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<td>5.7</td>
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</table>

FR1 = 0.64

9 Cutting Food and Handling Utensils in UPDRS: Eating Tasks in MDS-UPDRS

Direct mapping mechanism

<table>
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<th>Category</th>
<th>(a_j)</th>
<th>(b_{j,k})</th>
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<td>0.63</td>
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<td>&gt; 2</td>
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<td>2.8</td>
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<td></td>
<td>&gt; 3</td>
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<td>6.5</td>
</tr>
<tr>
<td></td>
<td>= 4</td>
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<td>8.5</td>
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</tbody>
</table>
### 10 Dressing in UPDRS: Dressing in MDS-UPDRS

Direct mapping mechanism

<table>
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<th>Category</th>
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<th>$b_{j,k}$</th>
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<td>$&gt; 3$</td>
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<tr>
<td></td>
<td>$= 4$</td>
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<td>6.6</td>
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</tbody>
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### 11 Hygiene in UPDRS: Hygiene in MDS-UPDRS

Direct mapping mechanism

<table>
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<th>Category</th>
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<th>$b_{j,k}$</th>
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<td>5.9</td>
</tr>
<tr>
<td></td>
<td>$= 4$</td>
<td></td>
<td>56</td>
</tr>
</tbody>
</table>

### 12 Turning in Bed and Adjusting Clothes in UPDRS: Turning in Bed in MDS-UPDRS

Indirect mapping mechanism: UPDRS $\rightarrow$ MDS-UPDRS

$0\rightarrow0$, $1\rightarrow1$, $2\rightarrow2|3$, $3\rightarrow3|4$, $4\rightarrow4$

\[
P(Y_{ij} = 0) = P_0
\]
\[
P(Y_{ij} = 1) = P_1
\]
\[
P(Y_{ij} = 2) = P_2 + P_3*FR_3
\]
\[
P(Y_{ij} = 3) = P_3*(1 - FR_3) + P_4*FR_4
\]
\[
P(Y_{ij} = 4) = P_4*(1 - FR_4)
\]

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
<th>$a_j$</th>
<th>$b_{j,k}$</th>
<th>$FR$</th>
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<tbody>
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<td>$&gt; 3$</td>
<td></td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$= 4$</td>
<td></td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** $FR_3 = 0$, $FR_4 = 0$
13 Falling in UPDRS
[In UPDRS only]

<table>
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<th>Category</th>
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<th>$b_{j,k}$</th>
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<tbody>
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<td>&gt; 2</td>
<td>1.3</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>&gt; 3</td>
<td></td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>= 4</td>
<td></td>
<td>56</td>
</tr>
</tbody>
</table>

14 Freezing When Walking in UPDRS: Freezing in MDS-UPDRS

*Unique parameterization: for probabilities of 2, 3, 4

\[ P(Y_{ij} = 0) = P_0 \]
\[ P(Y_{ij} = 1) = P_1 \]
\[ P(Y_{ij} = 2) = N_{P2} \]
\[ P(Y_{ij} = 3) = N_{P3} \]
\[ P(Y_{ij} = 4) = N_{P4} \]

<table>
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<td>&gt; 2</td>
<td>1.5</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>&gt; 3</td>
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<td>5.3</td>
</tr>
<tr>
<td></td>
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<td>7.1</td>
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</table>
15 Walking in UPDRS: Walking and Balance in MDS-UPDRS

Indirect mapping mechanism: UPDRS $\rightarrow$ MDS-UPDRS
0$\rightarrow$0, 1$\rightarrow$1, 2$\rightarrow$1|2, 3$\rightarrow$3|4, 4$\rightarrow$4

\[
P(Y_{ij} = 0) = P0 \\
P(Y_{ij} = 1) = P1*FR1 \\
P(Y_{ij} = 2) = P2 + P1*(1 - FR1) \\
P(Y_{ij} = 3) = P3 + P4*FR4 \\
P(Y_{ij} = 4) = P4*(1 - FR4)
\]

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
<th>$a_j$</th>
<th>$b_{j,k}$</th>
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<td>&gt; 3</td>
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<td>= 4</td>
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<td>54</td>
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16 Tremor in UPDRS: Tremor in MDS-UPDRS

Direct mapping mechanism

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17 Sensory Complaints related to Parkinson’s Disease in UPDRS: Pain and Other Sensations in MDS-UPRDS

Direct mapping mechanism

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<td></td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>= 4</td>
<td></td>
<td>54</td>
</tr>
</tbody>
</table>
18 Speech (Motor Examination) in UPDRS: Speech (Motor Examination) in MDS-UPDRS

Indirect mapping mechanism: UPDRS → MDS-UPDRS

$P(Y_{ij} = 0) = P0$
$P(Y_{ij} = 1) = P1$
$P(Y_{ij} = 2) = P2$
$P(Y_{ij} = 3) = P3 + P4 * FR4$
$P(Y_{ij} = 4) = P4 * (1 - FR4)$

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
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<th>$b_{j,k}$</th>
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19 Facial Expression in UPDRS: Facial Expression in MDS-UPDRS

Direct mapping mechanism

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</tr>
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</table>
## 20 Tremor at Rest in UPDRS

*Unique to UPDRS: As there is no parallelism to Rest Tremor Amplitude in MDS-UPDRS*

### (1) Face, Lips and Chin

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<th>Category</th>
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### (2) Left Upper Extremity

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### (3) Right Upper Extremity

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### (4) Left Lower Extremity

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### (5) Right Lower Extremity

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<td>= 4</td>
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<td>56</td>
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</table>
21 **Action/Postural Tremor in UPDRS**

*Unique to UPDRS: As there is no parallelism to ‘Postural Tremor’ and ‘Kinetic Tremor’ in MDS-UPDRS*

(1) **Left Hand**

<table>
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(2) **Right Hand**

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<td>&gt; 3</td>
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22 Rigidity in UPDRS: Rigidity in MDS-UPDRS

Indirect mapping mechanism: UPDRS $\rightarrow$ MDS-UPDRS

$0 \rightarrow 0, 1 \rightarrow 1, 2 \rightarrow 2, 3 \rightarrow 2, 4 \rightarrow 3|4$

\[
P(Y_{ij} = 0) = P0
\]
\[
P(Y_{ij} = 1) = P1
\]
\[
P(Y_{ij} = 2) = P2*FR2
\]
\[
P(Y_{ij} = 3) = P2*(1 - FR2) + P4*FR4
\]
\[
P(Y_{ij} = 4) = P3 + P4*(1 - FR4)
\]

(1) Neck

<table>
<thead>
<tr>
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<th>Category</th>
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<td>$&gt; 2$</td>
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<tr>
<td></td>
<td>$&gt; 3$</td>
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<td>4.6</td>
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</table>

$FR2 = 0.84$

$FR4 = 1$

(2) Left Upper Extremity

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
<th>$a_j$</th>
<th>$b_{j,k}$</th>
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<td>$&gt; 2$</td>
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</table>

$FR2 = 1$

$FR4 = 0.95$
Indirect mapping mechanism: UPDRS $\Rightarrow$ MDS-UPDRS

$0 \Rightarrow 0, \ 1 \Rightarrow 1, \ 2 \Rightarrow 2, \ 3 \Rightarrow 2, \ 4 \Rightarrow 3|4$

\[
P(Y_{ij} = 0) = P_0
\]
\[
P(Y_{ij} = 1) = P_1
\]
\[
P(Y_{ij} = 2) = P_2*FR_2
\]
\[
P(Y_{ij} = 3) = P_2*(1- FR_2) + P_4*FR_4
\]
\[
P(Y_{ij} = 4) = P_3 + P_4*(1- FR_4)
\]

(3) Right Upper Extremity

<table>
<thead>
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<th>$b_{j,k}$</th>
<th>$FR$</th>
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<td>$FR_2 = 0.82$</td>
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<td>$&gt;$ 2</td>
<td>1.2</td>
<td>-0.22</td>
<td>$FR_4 = 1$</td>
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<tr>
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<td>2.8</td>
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(4) Left Lower Extremity

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<td>3.6</td>
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(5) Right Lower Extremity

<table>
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<th>$b_{j,k}$</th>
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<td>$FR_4 = 1$</td>
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</table>
23 Finger Taps in UPDRS: Finger Taps in MDS-UPDRS

Indirect mapping mechanism: UPDRS ➔ MDS-UPDRS
0 ➔ 0, 1 ➔ 1|2, 2 ➔ 2|3, 3 ➔ 3, 4 ➔ 4

\[
P(Y_{ij} = 0) = P_0 \\
P(Y_{ij} = 1) = P_1 + P_2 \cdot FR_2 \\
P(Y_{ij} = 2) = P_2 \cdot (1 - FR_2) + P_3 \cdot FR_3 \\
P(Y_{ij} = 3) = P_3 \cdot (1 - FR_3) \\
P(Y_{ij} = 4) = P_4
\]

(1) Left Hand

<table>
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<th>(b_{j,k})</th>
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<td>1.3</td>
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<td>3.3</td>
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</tr>
<tr>
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<td></td>
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<td>(FR_2 = 0.20)</td>
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<tr>
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<td>(FR_3 = 0.45)</td>
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(2) Right Hand

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<td>&gt; 3</td>
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<td>(FR_3 = 0.41)</td>
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</table>
Hand Movements in UPDRS: Hand Movements in MDS-UPDRS

Indirect mapping mechanism: UPDRS \(\rightarrow\) MDS-UPDRS

\[\begin{align*}
0 & \rightarrow 0, & 1 & \rightarrow 1|2, & 2 & \rightarrow 2|3, & 3 & \rightarrow 3, & 4 & \rightarrow 4 \\
\end{align*}\]

\[
\begin{align*}
P(Y_{ij} = 0) &= P_0 \\
P(Y_{ij} = 1) &= P_1 + P_2 \cdot FR_2 \\
P(Y_{ij} = 2) &= P_2 \cdot (1 - FR_2) + P_3 \cdot FR_3 \\
P(Y_{ij} = 3) &= P_3 \cdot (1 - FR_3) \\
P(Y_{ij} = 4) &= P_4
\end{align*}
\]

(1) Left Hand

<table>
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<th>Item (-j)</th>
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<th>(b_{j,k})</th>
<th>(FR)</th>
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<td>FR3 = 0.52</td>
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<td>1.7</td>
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<td>= 4</td>
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(2) Right Hand

<table>
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<th>(b_{j,k})</th>
<th>(FR)</th>
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</table>
## 25 Hand Pronation and Supination in UPDRS: Hand Pronation and Supination in MDS-UPDRS

Indirect mapping mechanism: UPDRS $\rightarrow$ MDS-UPDRS

0 $\rightarrow$ 0, 1 $\rightarrow$ 1|2, 2 $\rightarrow$ 2|3, 3 $\rightarrow$ 3, 4 $\rightarrow$ 4

\[
P(Y_{ij} = 0) = P_0
\]

\[
P(Y_{ij} = 1) = P_1 + P_2 \cdot FR_2
\]

\[
P(Y_{ij} = 2) = P_2 \cdot (1 - FR_2) + P_3 \cdot FR_3
\]

\[
P(Y_{ij} = 3) = P_3 \cdot (1 - FR_3)
\]

\[
P(Y_{ij} = 4) = P_4
\]

(1) Left Hand

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(2) Right Hand

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<td>0.53</td>
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<td>&gt; 3</td>
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<td>4.5</td>
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</tbody>
</table>
26 Leg Agility in UPDRS: Leg Agility in MDS-UPDRS

Indirect mapping mechanism: UPDRS $\Rightarrow$ MDS-UPDRS

$0 \Rightarrow 0, \ 1 \Rightarrow 1|2, \ 2 \Rightarrow 2|3, \ 3 \Rightarrow 3, \ 4 \Rightarrow 4$

\[
P(Y_{ij} = 0) = P_0 \\
P(Y_{ij} = 1) = P_1 + P_2*FR_2 \\
P(Y_{ij} = 2) = P_2*(1- FR_2) + P_3*FR_3 \\
P(Y_{ij} = 3) = P_3*(1- FR_3) \\
P(Y_{ij} = 4) = P_4
\]

(1) Left Leg

<table>
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<th>$b_{j,k}$</th>
<th>FR</th>
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<td>0.92</td>
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</tr>
<tr>
<td></td>
<td>&gt; 3</td>
<td></td>
<td>3.0</td>
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FR2 = 0
FR3 = 0

(2) Right Leg

<table>
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<th>$b_{j,k}$</th>
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<td></td>
<td>&gt; 3</td>
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<td>4.5</td>
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</tr>
<tr>
<td></td>
<td>= 4</td>
<td></td>
<td>6.6</td>
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FR2 = 0
FR3 = 0
27 Arising From Chair in UPDRS: Arising From Chair in MDS-UPDRS

Direct mapping mechanism:

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<th>Category</th>
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<th>$b_{j,k}$</th>
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</thead>
<tbody>
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<td>27</td>
<td>&gt; 1</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 2</td>
<td>1.1</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>&gt; 3</td>
<td></td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>= 4</td>
<td></td>
<td>6.7</td>
</tr>
</tbody>
</table>

28 Posture in UPDRS: Posture in MDS-UPDRS

Indirect mapping mechanism: UPDRS $\Rightarrow$ MDS-UPDRS

$0 \Rightarrow 0$, $1 \Rightarrow 1$, $2 \Rightarrow 2|3$, $3 \Rightarrow 4$, $4 \Rightarrow 4$

\[
P(Y_{ij} = 0) = P_0 \\
P(Y_{ij} = 1) = P_1 \\
P(Y_{ij} = 2) = P_2 + P_3 \\
P(Y_{ij} = 3) = P_4*FR_4 \\
P(Y_{ij} = 4) = P_4*(1 - FR_4)
\]

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
<th>$a_j$</th>
<th>$b_{j,k}$</th>
<th>$FR$</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>&gt; 1</td>
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<td>-0.27</td>
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<td>&gt; 2</td>
<td>1.3</td>
<td>2.1</td>
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<tr>
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<td>&gt; 3</td>
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<td>4.2</td>
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<td>6.6</td>
<td>$FR_4 = 0.92$</td>
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</table>
29 Gait in UPDRS: Gait in MDS-UPDRS

Indirect mapping mechanism: UPDRS \( \rightarrow \) MDS-UPDRS

\[ 0 \rightarrow 0, 1 \rightarrow 1, 2 \rightarrow 2, 3 \rightarrow 3|4, 4 \rightarrow 4 \]

\[
\begin{align*}
P(Y_{ij} = 0) &= P_0 \\
P(Y_{ij} = 1) &= P_1 \\
P(Y_{ij} = 2) &= P_2 \\
P(Y_{ij} = 3) &= P_3 + P_4 \times FR_4 \\
P(Y_{ij} = 4) &= P_4 \times (1 - FR_4)
\end{align*}
\]

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
<th>(a_j)</th>
<th>(b_{j,k})</th>
<th>(FR)</th>
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</thead>
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<td>29</td>
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<td>8.4</td>
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FR\(_4 = 0\)

30 Postural Stability in UPDRS: Postural Stability in MDS-UPDRS

Indirect mapping mechanism: UPDRS \( \rightarrow \) MDS-UPDRS

\[ 0 \rightarrow 0, 1 \rightarrow 1|2, 2 \rightarrow 3, 3 \rightarrow 4, 4 \rightarrow 4 \]

\[
\begin{align*}
P(Y_{ij} = 0) &= P_0 \\
P(Y_{ij} = 1) &= P_1 + P_2 \\
P(Y_{ij} = 2) &= P_3 \\
P(Y_{ij} = 3) &= P_4 \times FR_4 \\
P(Y_{ij} = 4) &= P_4 \times (1 - FR_4)
\end{align*}
\]

<table>
<thead>
<tr>
<th>Item -j</th>
<th>Category</th>
<th>(a_j)</th>
<th>(b_{j,k})</th>
<th>(FR)</th>
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FR\(_4 = 0.93\)
31 Body Bradykinesia and Hypokinesia in UPDRS: Global Spontaneity of Movement in MDS-UPDRS

Direct mapping mechanism

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