This document provides a description of the columns in the CSV summary file generated by **START\_HrTimeSeries\_Analysis matlab** script.

# Columns Description

|  |  |  |
| --- | --- | --- |
| **Title** | **Units** | **Description** |
| **Particpant\_ID** |  | Participant identifier extracted from the scoring data file name. |
| **lights\_Off** | Time  (**hh:mm:ss PM**) | Time at which one starts trying to fall asleep |
| **lights\_On** | Time  (**hh:mm:ss AM**) | Time at which one is woken up (or recording ends) |
| **Pre\_Wake** | minutes | Number of minutes before first sleep period. |
| **Post\_Wake** | minutes | Number of minutes after last sleep period. |
| **TiB** | minutes | Time in Bed; time between Lights OFF and Lights ON |
| **SOL** | minutes | **Sleep Onset Latency;**  Time between Lights OFF and the 1st epoch of sleep  (i.e. how long does it take to fall asleep) |
| **WASO** | minutes | **Wake After Sleep Onset;** Time between 1st epoch of sleep and end of recording that was spent awake.  *Starting from first period of sleep and until the last period of sleep in the recording, all the epochs scored as wake.* |
| **REM\_Lat** | minutes | Rem Latency; Time between 1st epoch of sleep and 1st epoch of REM |
| **TST** | minutes | **Total Sleep Time;** Time during the recording that was spent asleep |
| **SE** | Percentage (%) | Sleep Efficiency (**TST** / **TiB** ) \*100  Reflects how consolidated/fragmented sleep is |
| **N1\_min** | minutes | Total number of minutes spent in the NREM 1 sleep stage. |
| **N2\_min** | minutes | Total number of minutes spent in the NREM 2 sleep stage. |
| **N3\_min** | minutes | Total number of minutes spent in the NREM 3 sleep stage. |
| **REM\_min** | minutes | Total number of minutes spent in the REM sleep stage. |
| **N1\_pc** | Percentage (%) | Percentage of Total Sleep Time spent in the NREM 1 sleep stage - (**N1\_min** / **TST**) \*100. |
| **N2\_pc** | Percentage (%) | Percentage of Total Sleep Time spent in the NREM 2 sleep stage - (**N2\_min** / **TST**) \*100. |
| **N3\_pc** | Percentage (%) | Percentage of Total Sleep Time spent in the NREM 3 sleep stage - (**N3\_min** / **TST**) \*100. |
| **REM\_pc** | Percentage (%) | Percentage of Total Sleep Time spent in the REM sleep stage - (**REM\_min** / **TST**) \*100. |
| Refer to section 2 (*Stage Period Rules*) for the sleep stage period identification rules. | | |
| **NREMp\_tot\_min** | minutes | Total number of minutes spent in the NREM sleep stage periods. |
| **NREMp\_tot\_pc** | Percentage (%) | Percentage of Total Sleep Time spent in the NREM sleep stage periods.  - 100 \* **NREMp\_tot\_min** / (**NREMp\_tot\_min + REMp\_tot\_min**) |
| The following seven (7) columns are repeated for all NREM periods.  The NREM periods are identified by numbers such as **NREMp1\_, NREMp2\_, NREMp3\_, …** | | |
| **NREMpX\_min** | minutes | Total number of minutes spent in the NREM period number **X**. |
| **NREMpX\_NREM\_pc** | Percentage (%) | Percentage of epochs in the NREM period **X** that are scored as NREM 1, NREM 2 or NREM 3. |
| **NREMpX\_N1\_pc** | Percentage (%) | Percentage of epochs in the NREM period **X** that are scored as NREM 1. |
| **NREMpX\_N2\_pc** | Percentage (%) | Percentage of epochs in the NREM period **X** that are scored as NREM 2. |
| **NREMpX\_N3\_pc** | Percentage (%) | Percentage of epochs in the NREM period **X** that are scored as NREM 3. |
| **NREMpX\_REM\_pc** | Percentage (%) | Percentage of epochs in the NREM period **X** that are scored as REM. |
| **NREMpX\_WAKE\_pc** | Percentage (%) | Percentage of epochs in the NREM period **X** that are scored as WAKE. |
| **REMp\_tot\_min** | minutes | Total number of minutes spent in the REM sleep stage periods. |
| **REMp\_tot\_pc** | Percentage (%) | Percentage of Total Sleep Time spent in the REM sleep stage periods.  - 100 \* **REMp\_tot\_min** / (**NREMp\_tot\_min + REMp\_tot\_min**) |
| The following seven (7) columns are repeated for all REM periods.  The REM periods are identified by numbers such as **REMp1\_, REMp2\_, REMp3\_, …** | | |
| **REMpX\_min** | minutes | Total number of minutes spent in the REM period number **X**. |
| **REMpX\_REM\_pc** | Percentage (%) | Percentage of epochs in the REM period **X** that are scored as REM. |
| **REMpX\_NREM\_pc** | Percentage (%) | Percentage of epochs in the REM period **X** that are scored as NREM 1, NREM 2 or NREM 3. |
| **REMpX\_N1\_pc** | Percentage (%) | Percentage of epochs in the REM period **X** that are scored as NREM 1. |
| **REMpX\_N2\_pc** | Percentage (%) | Percentage of epochs in the REM period **X** that are scored as NREM 2. |
| **REMpX\_N3\_pc** | Percentage (%) | Percentage of epochs in the REM period **X** that are scored as NREM 3. |
| **REMpX\_WAKE\_pc** | Percentage (%) | Percentage of epochs in the REM period **X** that are scored as WAKE. |
| The following columns are results referring to the Linear Regression Modeling of the Heart Rate (HR) Time Series. | | |
| **Slope\_Night** | BPM/second | Slope value of the linear regression fit of the HR time series for the complete night (excluding the Pre-Wake and Post-Wake periods). |
| The following column is repeated for all NREM periods. | | |
| **Slope\_NREMpX** | BPM/second | Slope value of the linear regression fit of the HR time series for the NREM period **X**. |
| The following column is repeated for all REM periods. | | |
| **Slope\_REMpX** | BPM/second | Slope value of the linear regression fit of the HR time series for the REM period **X**. |
| **Intercept\_Night** | second | Intercept value of the linear regression fit of the HR time series for the complete night (excluding the Pre-Wake and Post-Wake periods). |
| The following column is repeated for all NREM periods. | | |
| **Intercept\_NREMpX** | BPM/second | Intercept value of the linear regression fit of the HR time series for the NREM period **X**. |
| The following column is repeated for all REM periods. | | |
| **Intercept\_REMpX** | BPM/second | Intercept value of the linear regression fit of the HR time series for the REM period **X**. |
| **R2\_Night** |  | R2 factor value of the linear regression fit of the HR time series for the complete night (excluding the Pre-Wake and Post-Wake periods). |
| The following column is repeated for all NREM periods. | | |
| **R2\_NREMpX** |  | R2 factor value of the linear regression fit of the HR time series for the NREM period **X**. |
| The following column is repeated for all REM periods. | | |
| **R2\_REMpX** |  | R2 factor value of the linear regression fit of the HR time series for the REM period **X**. |
| **Delta\_Night** | BPM | Confidence factor (δ) value of the linear regression fit of the HR time series for the complete night (excluding the Pre-Wake and Post-Wake periods).  Note that the ±2δ interval corresponds to a 95% confidence interval. |
| The following column is repeated for all NREM periods. | | |
| **Delta\_NREMpX** |  | Confidence factor (δ) value of the linear regression fit of the HR time series for the NREM period **X**. |
| The following column is repeated for all REM periods. | | |
| **Delta\_REMpX** |  | Confidence factor (δ) value of the linear regression fit of the HR time series for the REM period **X**. |
| The following columns are results referring to the HRV analysis parameters extracted from the HR Time Series. | | |
| **HR\_WAKE** | BPM | Average Heart Rate value of all epochs scored as WAKE. |
| **HR\_N1** | BPM | Average Heart Rate value of all epochs scored as NREM 1. |
| **HR\_N2** | BPM | Average Heart Rate value of all epochs scored as NREM 1. |
| **HR\_N3** | BPM | Average Heart Rate value of all epochs scored as NREM 1. |
| **HR\_REM** | BPM | Average Heart Rate value of all epochs scored as REM. |
| **HR\_NREMp** | BPM | Average Heart Rate value of all epochs in all NREM periods. |
| The following column is repeated for all NREM periods. | | |
| **HR\_NREMpX** | BPM | Average Heart Rate value of all epochs in NREM period **X**. |
| **HR\_REMp** | BPM | Average Heart Rate value of all epochs in all REM periods. |
| The following column is repeated for all REM periods. | | |
| **HR\_REMpX** | BPM | Average Heart Rate value of all epochs in REM period **X**. |
| **RMSSD\_WAKE** | second | RMSSD value computed from all epochs scored as WAKE. |
| **RMSSD\_N1** | second | RMSSD value computed from all epochs scored as NREM 1. |
| **RMSSD\_N2** | second | RMSSD value computed from all epochs scored as NREM 1. |
| **RMSSD\_N3** | second | RMSSD value computed from all epochs scored as NREM 1. |
| **RMSSD\_REM** | second | RMSSD value computed from all epochs scored as REM. |
| **RMSSD\_NREMp** | second | RMSSD value computed from all epochs in all NREM periods. |
| The following column is repeated for all NREM periods. | | |
| **RMSSD\_NREMpX** | second | RMSSD value computed from all epochs in NREM period **X**. |
| **RMSSD\_REMp** | second | RMSSD value computed from all epochs in all REM periods. |
| The following column is repeated for all REM periods. | | |
| **RMSSD\_REMpX** | second | RMSSD value computed from all epochs in REM period **X**. |
| **SDNN\_WAKE** | second | SDNN value computed from all epochs scored as WAKE. |
| **SDNN\_N1** | second | SDNN value computed from all epochs scored as NREM 1. |
| **SDNN\_N2** | second | SDNN value computed from all epochs scored as NREM 1. |
| **SDNN\_N3** | second | SDNN value computed from all epochs scored as NREM 1. |
| **SDNN\_REM** | second | SDNN value computed from all epochs scored as REM. |
| **SDNN\_NREMp** | second | SDNN value computed from all epochs in all NREM periods. |
| The following column is repeated for all NREM periods. | | |
| **SDNN\_NREMpX** | second | SDNN value computed from all epochs in NREM period **X**. |
| **SDNN\_REMp** | second | SDNN value computed from all epochs in all REM periods. |
| The following column is repeated for all REM periods. | | |
| **SDNN\_REMpX** | second | SDNN value computed from all epochs in REM period **X**. |
| The following four (4) columns can be used as an indicator of the input data quality and confidence factor in the data results. | | |
| **MissingPercent** | Percentage (%) | Percentage of missing data in the digitized ECG waveform.  Proposed threshold value: 10%. |
| **CorrectedPercent** | Percentage (%) | Percentage of IBI values that were interpolated.  Proposed threshold value: 6%. |
| **DataQualityFactor** | Percentage (%) | This variable is a combination of the above two (**MissingPercent** and **CorrectedPercent**).  **DataQualityFactor = 100\*(1– MissingPercent/100) \* (1 - CorrectedPercent)**  Proposed threshold value: 80%. |
| **ValidEpochPercent** | Percentage (%) | This variable is computed in the pipeline’s epoch validation stage.  An epoch is considered valid if the summation of IBI values in the epoch is within 1% of its duration.  If the epochs’ duration is 30 seconds then an epoch is considered valid if the summation of its IBI values is in the interval [29.7, 30.3] seconds.  Proposed threshold value: 70%. |

# Stage Period Rules

## Define NREM period (NREMp)

* Starts with the first epoch of Stage 2, 3, or 4 (indicated in txt file as either "Stage 2, Stage 3, or Stage 4" or "NREM2, NREM3, or NREM4");
* Ends with the epoch preceding the first epoch of REM (indicated in txt file as "REM") **or** the last period of wake (indicated in the txt files as "Wake") of a continuous bout of at least 5 minutes of REM (no duration criteria for the first and last REM periods) or Wake (only the last bout of wake in the end of the recording; in the end, there should be no "wake" period cutting the NREM in the middle );
* At least 15min duration.

## Define REM period (REMp)

* Time intervals between two consecutive NREM period**or**the time interval between the last NREM period and the final awakening (indicated in the text file as continuous "Wake" epochs until the end of the recording);
* At least 5 min duration but no minimum duration for the first and last REM episode;
* (Thus **occasional stage 1 epochs**between REMS and stage 2 are included in the REM episode).