**HRV Table**

This section contains information on the HRV table from the hard-coded script.

|  |  |  |  |
| --- | --- | --- | --- |
| HRV |  |  |  |
| Variable | Type | Range | Information |
| hrv\_id | Integer | 1-500 | ID for week/user combination |
| hrv\_week | Integer | 1-10 | Data was collected over 10 weeks; this variable indicates which week the data is from. |
| hrv\_hrv | Integer | 14-24\* | Average nightly heart rate variability. |
| hrv\_sdd\_1\_4 | Integer | 5-10\* | Number of hours of sleep for the first day of the week |
| hrv\_sdd\_2\_4 | Integer | 5-10\* | Number of hours of sleep for the second day of the week |
| hrv\_sdd\_3\_4 | Integer | 5-10\* | Number of hours of sleep for the third day of the week |
| hrv\_sdd\_4\_4 | Integer | 5-10\* | Number of hours of sleep for the fourth day of the week |
| hrv\_sdd\_5\_4 | Integer | 5-10\* | Number of hours of sleep for the fifth day of the week |
| hrv\_sdd\_6\_4 | Integer | 6-10\* | Number of hours of sleep for the sixth day of the week |
| hrv\_sdd\_7\_4 | Integer | 7-10\* | Number of hours of sleep for the seventh day of the week |
| hrv\_slp | Integer | 1-3 | Average sleep quality rating for the week. Randomly generated except for particular user stories. |
| person\_id | Integer | 1-50 | User ID |
| Notes | String |  | Describes the story for users who have personal user stories. NA otherwise. |

\*Users with personal user stories may have some values fall outside these ranges. These ranges were chosen to limit variability to make particular user stories more interesting. Values were randomly generated from these ranges except for particular user stories.

All code was done in R. The sample() function was used for random number generation.

|  |  |
| --- | --- |
| HRV Personal User Stories |  |
| person\_id | Story |
| 44 | A mix of consistent sleep hours/quality and inconsistent sleep hours/quality |
| 2 | A mix of consistent sleep hours/quality and inconsistent sleep hours/quality |
| 25 | Consistent and now inconsistent sleep hours/quality |
| 12 | Inconsistent and now consistent sleep hours/quality |
| 35 | Sleeps well during the week but not on weekends |
| 18 | Sleeps well on weekends but not during the week |
| 48 | Consistent HRV values |
| 4 | Inconsistent HRV values |

The users were generated using the sample() function in R.

**Oura\_Ring\_Sleep Table**

This section contains information on the Oura\_Ring\_Sleep Table from the hard-coded script.

|  |  |  |  |
| --- | --- | --- | --- |
| Oura\_Ring\_Sleep |  |  |  |
| Variable | Type | Range | Information |
| person\_id | Integer | 1-50 | User ID |
| breath\_average | Floating point | 12-20 | Average respiratory rate in breaths per minute |
| restless | Integer | 1-100, 0 if not available | Percentage of sleep time user was moving |
| score\_alignment | Integer | 1-100, 0 if not available | Weight 0.10 in the sleep score calculation. Circadian alignment’s contribution for sleep score. Randomly generated. |
| score\_deep | Integer | 1-100, 0 if not available | Weight 0.10 in the sleep score calculation. Deep sleep time’s contribution for sleep score. Randomly generated. |
| score\_disturbances | Integer | 1-100, 0 if not available | Weight 0.15 in the sleep score calculation. Sleep disturbance’s contribution for sleep score. Randomly generated. |
| score\_efficiency | Integer | 1-100, 0 if not available | Weight 0.10 in sleep score calculation. Efficiency’s contribution for sleep score. Randomly generated. |
| score\_latency | Integer | 1-100, 0 if not available | Weight 0.10 in sleep score calculation. Sleep onset latency’s contribution for sleep score. Randomly generated |
| score\_rem | Integer | 1-100, 0 if not available | Weight 0.10 in sleep score calculation. REM sleep time’s contribution for sleep score. Randomly generated. |
| score\_total | Integer | 1-100, 0 if not available. | Weight 0.35 in sleep score calculation. Total sleep time’s contribution for sleep score. Randomly generated. |
| score | Integer | 1-100, 0 if not available | Overall sleep quality during the sleep period. Calculated as a weighted average of sleep score contributors. |
| summary\_date | String |  | One day before the sleep period ended. Data for all users was generated over the same three-month period. |
| bedtime\_start | String | With the exception of particular user stories, this value always falls between 19:00 and 23:00 to limit variability. The times were randomly generated from between 19:00 and 23:00. | Local time when the sleep period started. |
| bedtime\_end | String | With the exception of particular user stories, this value always falls between 6:00 and 11:00 to limit variability. The times were randomly generated from between 6:00 and 11:00. | Local time when the sleep period ended |
| duration | Integer |  | Total duration of sleep period (bedtime\_end-bedtime\_start) in seconds |
| timzeone | Integer | -660-660 | Time offset from UTC in minutes |
| bedtime\_start\_delta | Integer |  | bedtime\_start[t]-bedtime\_start[t-1] in seconds |
| bedtime\_end\_delta | Integer |  | bedtime\_end[t]-bedtime\_end[t-1] in seconds |
| deep | Integer |  | Total amount of deep sleep registered during the sleep period in seconds. A percentage of sleep time spent in deep sleep (based on average percentage of sleep time spent in deep sleep) was randomly generated and multiplied by duration. |
| light | Integer |  | Total amount of light sleep registered during the sleep period in seconds. A percentage of sleep time spent in light sleep (based on average percentage of sleep time spent in light sleep) was randomly generated and multiplied by duration. |
| rem | Integer |  | Total amount of REM sleep registered during the sleep period in seconds. A percentage of sleep time spent in REM sleep (based on average percentage of sleep time spent in REM sleep) was randomly generated and multiplied by duration. |
| awake | Integer |  | Total amount of awake time registered during the sleep period in seconds. The percentage of the sleep period spent awake was calculated from by adding up the percentages of sleep time spent in deep sleep, light sleep, and REM sleep and subtracting this sum from 1. The awake percentage was then multiplied by duration. |
| total | Integer |  | deep+light+rem |
| period\_id | Integer |  | Index of the sleep period among sleep periods with the same summary\_date, where 0 = first sleep period of the day. |
| hr\_5min | Array of integers | With the exception of particular user stories, this value was randomly generated from 75-85 to limit variability. | Average heart rate (beats/min) for each beginning 5 minutes of the sleep period, the first period starting from bedtime\_start. |
| hr\_avg | Integer |  | The average heart rate registered during the sleep period (beats/min) |
| hr\_lowest | Integer |  | The lowest heart rate registered during the sleep period (beats/min) |
| hypnogram\_5min | String |  | A string that contains one character for each starting five minutes of the sleep period, so that the first period starts from sleep.bedtime.start: - '1' = deep (N3) sleep - '2' = light (N1 or N2) sleep - '3' = REM sleep - '4' = awake. Randomly generated for every 5 minutes of the sleep duration (may be inconsistent with deep, light, rem, and awake values). |
| efficiency | Integer | 0-100 | The percentage of the sleep period spent asleep (total/duration\*100) |
| onset\_latency | Integer | 120-3600 | Detected latency from bedtime\_start to the beginning of the first five minutes of persistent sleep. |
| midpoint\_time | Integer |  | The time in seconds from the start of sleep to the midpoint of sleep. The midpoint ignores awake periods. (total/2) |
| temperature\_delta | Float | -1-1 | Skin temperature deviation from the long-term temperature average (Celsius). |
| Notes | String |  | Describes the story for users who have personal user stories. NA otherwise. |

Some variables from the Oura Ring documentation were included as columns with NA values in this table. These are is\_longest, temperature\_deviation, temperature\_trend\_deviation, midpoint\_at\_delta, rmssd\_5min, and rmssd.

All of the code was written in R. The sample() function was used to for random generation. The lubridate library was used to create the dates, datetimes, and durations. These were then converted to integers or characters.

|  |  |
| --- | --- |
| Oura\_Ring\_Sleep Personal User Stories |  |
| person\_id | Story |
| 31 | Consistent scoring |
| 9 | Consistent bedtime |
| 46 | Consistent duration |
| 37 | Consistent bedtime and duration |
| 5 | Inconsistent bedtime |
| 4 | Inconsistent duration |
| 39 | Inconsistent bedtime and inconsistent duration |
| 34 | Consistent to sporadic duration |
| 24 | Sporadic to consistent wake ups |
| 46 | Consistent Heart Rate |
| 22 | Inconsistent Heart Rate |

The users were generated using the sample() function in R, and there was an attempt to limit the number of users with more than one story in this table and the HRV table.

**HRV Data Function**

This section details the inputs to the R function create\_HRV, which generates synthetic data for the HRV table.

|  |  |  |
| --- | --- | --- |
| create\_HRV |  |  |
| Input Variable | Input | Implementation\* |
| num\_people | Integer | Maximum person\_id |
| num\_week | Integer | Maximum hrv\_week |
| story1 | Integer | Number of people assigned to user story 1 |
| story2 | Integer | Number of people assigned to user story 2 |
| story3 | Integer | Number of people assigned to user story 3 |
| story4 | Integer | Number of people assigned to user story 4 |
| story5 | Integer | Number of people assigned to user story 5 |
| story6 | Integer | Number of people assigned to user story 6 |
| story7 | Integer | Number of people assigned to user story 7 |
| story8 | Integer | Number of people assigned to user story 8 |
| hrv\_range | Vector | Range for hrv\_hrv |
| hrv\_sdd\_1\_4 | Vector | Range for hrv\_sdd\_1\_4 |
| hrv\_sdd\_2\_4 | Vector | Range for hrv\_sdd\_2\_4 |
| hrv\_sdd\_3\_4 | Vector | Range for hrv\_sdd\_3\_4 |
| hrv\_sdd\_4\_4 | Vector | Range for hrv\_sdd\_4\_4 |
| hrv\_sdd\_5\_4 | Vector | Range for hrv\_sdd\_5\_4 |
| hrv\_sdd\_6\_4 | Vector | Range for hrv\_sdd\_6\_4 |
| hrv\_sdd\_7\_4 | Vector | Range for hrv\_sdd\_7\_4 |
| slp\_range | Vector | Range for hrv\_sdd\_8\_4 |

\*Information on these variables and appropriate values can be found above. The default values are based on the previous table for HRV.

The calculations for personal user stories 1-4 were changed from the original script for this function to be more flexible.

**Oura\_Ring\_Sleep Data Function**

This section details the inputs to the R function create\_Sleep, which generates data for the Oura\_Ring\_Sleep table. The lubridate library is required for this function.

|  |  |  |
| --- | --- | --- |
| create\_Sleep |  |  |
| Input Variable | Input | Implementation\* |
| num\_people | Integer | Maximum for person\_id |
| story1 | Integer | Number of people assigned to user story 1 |
| story2 | Integer | Number of people assigned to user story 2 |
| story3 | Integer | Number of people assigned to user story 3 |
| story4 | Integer | Number of people assigned to user story 4 |
| story5 | Integer | Number of people assigned to user story 5 |
| story6 | Integer | Number of people assigned to user story 6 |
| story7 | Integer | Number of people assigned to user story 7 |
| story8 | Integer | Number of people assigned to user story 8 |
| story9 | Integer | Number of people assigned to user story 9 |
| story10 | Integer | Number of people assigned to user story 10 |
| story11 | Integer | Number of people assigned to user story 11 |
| start\_date | String (i.e., "2019-06-01") | Default: "2019-06-01" |
| end\_date | String (i.e., "2019-09-01") | Default: "2019-09-01" |
| breath\_range | Vector | Range for breath\_average  Default: seq(12, 20, 0.01) |
| restless\_range | Vector | Range for restless |
| score\_alignment\_range | Vector | Range for score\_alignment |
| score\_deep\_range | Vector | Range for score\_deep |
| score\_disturbances\_range | Vector | Range for score\_disturbances |
| score\_efficiency\_range | Vector | Range for score\_efficiency |
| score\_latency\_range | Vector | Range for score\_latency |
| score\_rem\_range | Vector | Range for score\_rem |
| score\_total | Vector | Range for score\_total |
| hours\_bedtime\_range | Vector | Range for hours for bedtime\_start |
| hours\_wake\_range | Vector | Range for hours for bedtime\_end |
| tz\_range | Vector | Range for timezone in hours |
| deepPer\_range | Vector | Range of proportions for sleep time spent in deep sleep  Default: seq(0.13, 0.2, 0.01) |
| lightPer\_range | Vector | Range of proportions for sleep time spent in light sleep  Default: seq(0.45, 0.5, 0.01) |
| REMPer\_range | Vector | Range of proportions (as decimals) for sleep time spent in REM sleep  Default: seq(0.2, 0.2, 0.01) |
| hr\_range | Vector | Range for hr\_5min |
| onset\_latency\_range | Vector | Range for onset\_latency |
| temp\_delta\_range | Vector | Range for temperature\_delta  Default: seq(-1, 1, 0.01) |

\*Information on these variables and appropriate values can be found above. The default values are based on the previous table for Oura\_Ring\_Sleep. The default values have been provided if they were not inferable from earlier table.

The calculations for personal user stories 8 and 9 were changed from the original script for this function to be more flexible.

References

This section includes links to material that was used in deciding the ranges of some values.

<https://www.whoop.com/thelocker/stages-of-sleep-cycles/>

<https://www.cnet.com/health/sleep/sleeping-heart-rate-breathing-rate-and-hrv-what-your-sleep-data-means/#:~:text=During%20sleep%2C%20expect%20your%20heart,per%20minute%2C%20or%20even%20slower>.