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Dataset Chosen: Human Activity Analytics

Business Problem Statement:

"How can we improve the overall health and wellness of individuals by analyzing their daily activity patterns, sleep quality, and weight management?"

Project Goals and Objectives:

1. Goal:

- **To analyze and understand the relationship between daily activities, sleep patterns, and weight management to provide actionable insights that can help individuals improve their health and wellness.**

2. Objectives:

- **Identify key activity patterns (steps, active minutes) that correlate with healthy weight management.**
- **Examine the impact of sleep quality on daily activities and overall health.**
- **Determine the factors contributing to higher calorie expenditure and how they relate to weight loss or maintenance.**
- **Provide personalized recommendations for improving physical activity, sleep, and weight based on the analysis.**

Files Metadata

1. dailyActivity_merged.csv

• Columns:

- **Id (int64):** Unique identifier for each user.
- **ActivityDate (datetime):** Date of activity.
- **TotalSteps (int64):** Total number of steps taken.
- **TotalDistance (float64):** Total distance covered (in miles or kilometers).
- **TrackerDistance (float64):** Distance tracked by the device.
- **LoggedActivitiesDistance (float64):** Distance from logged activities.
- **VeryActiveDistance (float64):** Distance covered during very active minutes.
- **ModeratelyActiveDistance (float64):** Distance covered during moderately active minutes.
- **LightActiveDistance (float64):** Distance covered during light activity.
- **SedentaryActiveDistance (float64):** Distance covered during sedentary activity.
- **VeryActiveMinutes (int64):** Minutes of very active activity.

- FairlyActiveMinutes (int64): Minutes of fairly active activity.
- LightlyActiveMinutes (int64): Minutes of light activity.
- SedentaryMinutes (int64): Minutes of sedentary activity.
- Calories (int64): Calories burned.

2. dailyCalories_merged.csv

- **Columns:**
 - Id (int64): Unique identifier for each user.
 - ActivityDay (datetime): Date of activity.
 - Calories (int64): Calories burned.

3. dailyIntensities_merged.csv

- **Columns:**
 - Id (int64): Unique identifier for each user.
 - ActivityDay (datetime): Date of activity.
 - SedentaryMinutes (int64): Minutes of sedentary activity.
 - LightlyActiveMinutes (int64): Minutes of light activity.
 - FairlyActiveMinutes (int64): Minutes of fairly active activity.
 - VeryActiveMinutes (int64): Minutes of very active activity.
 - SedentaryActiveDistance (float64): Distance during sedentary minutes.
 - LightActiveDistance (float64): Distance during lightly active minutes.
 - ModeratelyActiveDistance (float64): Distance during moderately active minutes.
 - VeryActiveDistance (float64): Distance during very active minutes.

4. dailySteps_merged.csv

- **Columns:**
 - Id (int64): Unique identifier for each user.
 - ActivityDay (datetime): Date of activity.
 - StepTotal (int64): Total steps taken.

5. sleepDay_merged.csv

- **Columns:**

- Id (int64): Unique identifier for each user.
- SleepDay (datetime): Date and time of sleep recording.
- TotalSleepRecords (int64): Number of sleep records for that day.
- TotalMinutesAsleep (int64): Total minutes asleep.
- TotalTimeInBed (int64): Total time spent in bed.

6. weightLogInfo_merged.csv

- **Columns:**
 - Id (int64): Unique identifier for each user.
 - Date (datetime): Date and time of weight recording.
 - WeightKg (float64): Weight in kilograms.
 - WeightPounds (float64): Weight in pounds.
 - BMI (float64): Body Mass Index.
 - IsManualReport (bool): Whether the report was manually entered.
 - LogId (int64): Unique log identifier.

Univariate Analysis Summary

1. Daily Activity

- **Total Steps:**
 - Mean: ~7,638 steps
 - Standard deviation: ~5,087 steps.
 - Maximum steps recorded: 36,019 steps.
- **Calories Burned:**
 - Mean: ~2,303 calories
 - Standard deviation: ~718 calories.
 - Maximum calories burned: 4,900 calories.
- **Sedentary Minutes:**
 - Mean: ~991 minutes (~16.5 hours)

2. Daily Calories

- **Calories:**
 - Similar statistics to the Calories column in the daily activity dataset since they measure the same variable.

3. Daily Intensities

- **Sedentary Minutes:**
 - Mode: ~991 minutes.
- **Lightly Active Minutes:**
 - Mean: ~193 minutes (~3.2 hours)

- Range: 0 to 518 minutes.
- **Very Active Minutes:**
 - Mean: ~21 minutes

4. Daily Steps

- **Step Total:**
 - Mean: ~7,638 steps

5. Sleep Data

- **Total Minutes Asleep:**
 - Mean: ~419 minutes (~7 hours)
- **Total Time in Bed:**
 - Mean: ~458 minutes (~7.6 hours)

6. Weight Log

- **Weight (Kg):**
 - Mean: ~72 kg
 - Range: 52.6 kg to 133.5 kg
- **BMI:**
 - Mean: ~25.2

Bivariate Analysis Summary

1. Scatter Plots

- **Total Steps vs. Calories (Daily Activity):**
 - A positive correlation is observed between total steps and calories burned, indicating that more steps generally result in more calories burned.
- **Very Active Minutes vs. Calories (Daily Activity):**
 - A strong positive relationship is evident, suggesting that very active minutes have a significant impact on calories burned.
- **Total Time in Bed vs. Total Minutes Asleep (Sleep Data):**
 - A strong positive correlation shows that more time spent in bed typically results in more minutes asleep, though the relationship is not perfectly linear, indicating some inefficiencies in sleep.

2. Correlation Matrices

- **Daily Activity:**
 - **Total Steps** and **Total Distance** have a very high correlation (~0.985), which is expected as distance is directly related to the number of steps.
 - **Very Active Minutes** and **Calories** also show a strong positive correlation, reinforcing the scatter plot finding.

- **Daily Intensities:**
 - **Fairly Active Minutes** and **Moderately Active Distance** have a near-perfect correlation (~ 0.947), suggesting that fairly active minutes are strongly tied to moderately active distances.
 - **Very Active Minutes** and **Very Active Distance** are also highly correlated (~ 0.827), consistent with expectations.
- **Sleep Data:**
 - **Total Minutes Asleep** and **Total Time in Bed** have a very strong positive correlation (~ 0.930), indicating a close relationship between these two metrics.
- **Weight Log:**
 - **Weight (Kg)** and **BMI** show a strong positive correlation (~ 0.736), as BMI is directly calculated from weight.
 - A notable negative correlation is observed between **IsManualReport** and **Weight (Kg)** (-0.875), suggesting that manually reported weights are generally lower.

Multivariate Analysis Summary

1. Daily Activity

- **Pair Plot:**
 - Strong positive relationships are observed between TotalSteps, TotalDistance, and Calories.
 - VeryActiveMinutes shows a clear positive correlation with Calories, further emphasizing the impact of high-intensity activity on calorie expenditure.
- **Heatmap:**
 - The correlation matrix highlights strong correlations between TotalSteps and TotalDistance (~ 0.985), and VeryActiveMinutes with VeryActiveDistance (~ 0.795), which is expected given the nature of the data.

2. Sleep Data

- **Pair Plot:**
 - The plot shows a strong positive relationship between TotalMinutesAsleep and TotalTimeInBed, though there is some scatter, indicating variability in sleep efficiency.
- **Heatmap:**

- The correlation between TotalMinutesAsleep and TotalTimeInBed (~0.930) is very strong, supporting the observation that time in bed is a strong predictor of sleep duration.

3. Weight Log

- **Pair Plot:**
 - A strong positive correlation is visible between WeightKg and BMI, as expected.
- **Heatmap:**
 - The correlation between WeightKg and BMI (~0.736) is strong, indicating that higher weights are generally associated with higher BMIs.

Key Findings

A. Physical Activity and Caloric Burn

- **Correlation between Steps and Calories:**
 - A strong positive correlation was found between the number of steps taken and the calories burned. This indicates that increasing daily step counts is a reliable way to enhance caloric expenditure.
 - **Insight:** Users aiming to increase calorie burn should focus on consistently meeting or exceeding daily step goals.
- **Impact of High-Intensity Activity:**
 - Very active minutes showed a significant correlation with calories burned, highlighting the importance of incorporating high-intensity activities into daily routines.
 - **Insight:** Engaging in more high-intensity activities, even for short durations, can substantially boost calorie burn and improve cardiovascular health.

B. Sleep Patterns

- **Time in Bed vs. Sleep Efficiency:**
 - The analysis revealed a strong correlation between total time in bed and total minutes asleep. However, some variability suggests that not all time in bed is spent asleep, indicating potential inefficiencies.
 - **Insight:** Users should monitor not just the quantity of sleep but also its quality. Interventions such as consistent sleep schedules or improved sleep environments could enhance sleep efficiency.

C. Weight Management

- **Weight and BMI Relationship:**
 - A strong correlation between weight (in kg) and BMI was observed, reinforcing BMI as a useful indicator of health status related to body weight.
 - **Insight:** Users should be educated on the importance of maintaining a healthy BMI through balanced diets and regular physical activity.

Recommendations

A. Encouraging Physical Activity

- **Increase Daily Steps:**
 - Introduce step challenges or personalized step goals to motivate users to increase their daily activity levels.
 - **Action:** Implement app notifications or reminders to encourage users to take more steps, especially during sedentary periods.
- **Incorporate High-Intensity Workouts:**
 - Promote short, high-intensity workouts that users can incorporate into their daily routines, even with time constraints.
 - **Action:** Provide access to quick workout routines and encourage tracking of high-intensity minutes.

B. Improving Sleep Quality

- **Sleep Education Programs:**
 - Educate users on the importance of sleep quality and offer tips for improving sleep efficiency, such as maintaining a regular sleep schedule or creating a better sleep environment.
 - **Action:** Develop in-app content or notifications that provide personalized sleep tips based on users' sleep patterns.
- **Monitor Sleep Efficiency:**
 - Encourage users to not only track the amount of sleep they get but also to monitor their sleep efficiency to identify areas for improvement.
 - **Action:** Offer insights within the app that help users understand their sleep efficiency and suggest adjustments accordingly.

C. Personalized Health Recommendations

- **Tailored Health Plans:**
 - Based on the relationship between weight, BMI, and physical activity, create personalized health plans that guide users towards maintaining a healthy BMI.
 - **Action:** Develop algorithms that recommend specific activities and dietary changes to users based on their weight and BMI data.

Conclusion

The analysis of human activity data has provided valuable insights into the factors that influence caloric burn, sleep quality, and weight management. By implementing the recommended actions, users can be better supported in achieving their health and wellness goals, leading to improved outcomes. The findings underscore the importance of a holistic approach to health, where physical activity, sleep, and weight management are all interlinked and equally important.

Next Steps

- **Implementation:** Begin integrating these findings into the app or platform to enhance user engagement and improve health outcomes.
- **Further Research:** Conduct further analysis on how these recommendations impact user behaviour and health metrics over time.