PROJECT

(Research Paper: Biomechanical features of orthopedic patients)

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Abstract:

This research paper explores an, in depth analysis of a dataset that includes characteristics of patients. The goal is to examine how these features are distributed and interconnected as to visually compare normal and abnormal patient categories. By employing a range of visualization methods such, as scatter plots, pair plots, correlation matrices and box plots we reveal patterns and valuable insights hidden within the data.

Introduction:

It's important to grasp the aspects of patients, with issues to ensure precise diagnosis and treatment. Exploratory Data Analysis (EDA) serves as a tool for summarizing dataset traits often using aids. In this study we perform EDA on a dataset comprising measurements to detect patterns and variances between irregular patient groups. This initial examination aids, in pinpointing features and connections that can steer research or clinical judgments.

Related Work:

The exploration of biomechanical features in orthopedic patients has been significantly advanced by integrating technology and data analysis. Armand et al. (2004) emphasized the importance of biomechanical feedback in computer-aided orthopedic surgery, enhancing surgical precision and outcomes. Caggiari et al. (2020) demonstrated the potential of machine learning in biomechanical monitoring for detecting lying postures, improving patient monitoring systems. Further, Caggiari et al. (2021) focused on posture and mobility detection to prevent pressure ulcers, highlighting the role of biomechanical risk assessment in preventive healthcare. These studies provide a foundation for the current research, which employs Exploratory Data Analysis (EDA) to uncover patterns and variances in orthopedic patient data, using visualization methods to differentiate between normal and abnormal patient categories.

Methodology:

Data Collection

In this study the dataset comprises characteristics of **310 individuals**. These characteristics encompass;

- Pelvic_incidence
- Pelvic_tilt numeric
- Lumbar_lordosis_angle
- Sacral_slope
- Pelvic_radius
- Degree_spondylolisthesis
- Class (Normal or Abnormal)

Data Loading and Inspection

○ Loading the Dataset:

The dataset is loaded using **“pandas”** and its structure is inspected to understand **data types** and **check for missing values**. ○ Basic Data Information:

We use **“data.info()”**, **“data.head()”**, and **“data.describe()”** to get an overview of the dataset, including **data types**, **summary statistics**, and a **preview of the first few rows**.

○ Checking for Missing Values:

We check for missing values using **“data.isnull().sum()”**, **ensuring data completeness**.

Exploratory Data Analysis:

Pair Plot:

- ○ Purpose**:** Visualizes relationships between all pairs of features, helping to understand interactions and differences across classes.
- ○ How It Works: Uses the “**pairplot function**” from **“seaborn”** to **create a grid of scatter plots for each pair of features, colored by class**.

Scatter Plot:

- ○ Purpose: Visualizes the relationship between two specific features, **showing differences between normal and abnormal classes.**

- How It Works: Plots "**pelvic_incidence vs. pelvic_radius**" using "`plt.scatter`", with different colors **representing normal (green) and abnormal (red) classes**

Correlation Matrix:

- Purpose: Shows the **linear relationships** between features, helping identify highly correlated features.
- How It Works: Uses **"corr function"** to **calculate correlation coefficients, and heatmap from seaborn to visualize them.**

Box Plots:

- Purpose: Visualizes the **distribution of each feature across classes, highlighting differences and outliers**.
- How It Works: Uses "**sns.boxplot**" to create box plots for each feature, **separated by class (Normal and Abnormal).**

Results

The EDA reveals several insights: ○ Identification of Key Features: The

exploratory data analysis (EDA) highlighted characteristics that exhibit notable distinctions, between regular and irregular categories. These attributes are valuable, for examination and constructing models.

- Visual Insights: The visualizations provided clear insights into the data distribution and relationships, which are crucial for understanding the underlying patterns.

- No Missing Data: The dataset was found to be complete with no missing values, ensuring the reliability of the analysis

References:

- Armand, M., Lepistö, J. V., Merkle, A. C., Tallroth, K., Liu, X., Taylor, R. H., & Wenz, J. (2004). Computer-aided orthopedic surgery with near-real-time biomechanical feedback. *Johns Hopkins APL technical digest*, *25*(3), 242-252.
- Caggiari, S., Worsley, P. R., Payan, Y., Bucki, M., & Bader, D. L. (2020). Biomechanical monitoring and machine learning for the detection of lying postures. *Clinical Biomechanics*, *80*, 105181.
- Caggiari, S., Worsley, P. R., Fryer, S. L., Mace, J., & Bader, D. L. (2021). Detection of posture and mobility in individuals at risk of developing pressure ulcers. *Medical Engineering & Physics*, *91*, 39-47.