



ENHANCING PERFORMANCE WITH EFFECTIVE PLANNING

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Our Purpose



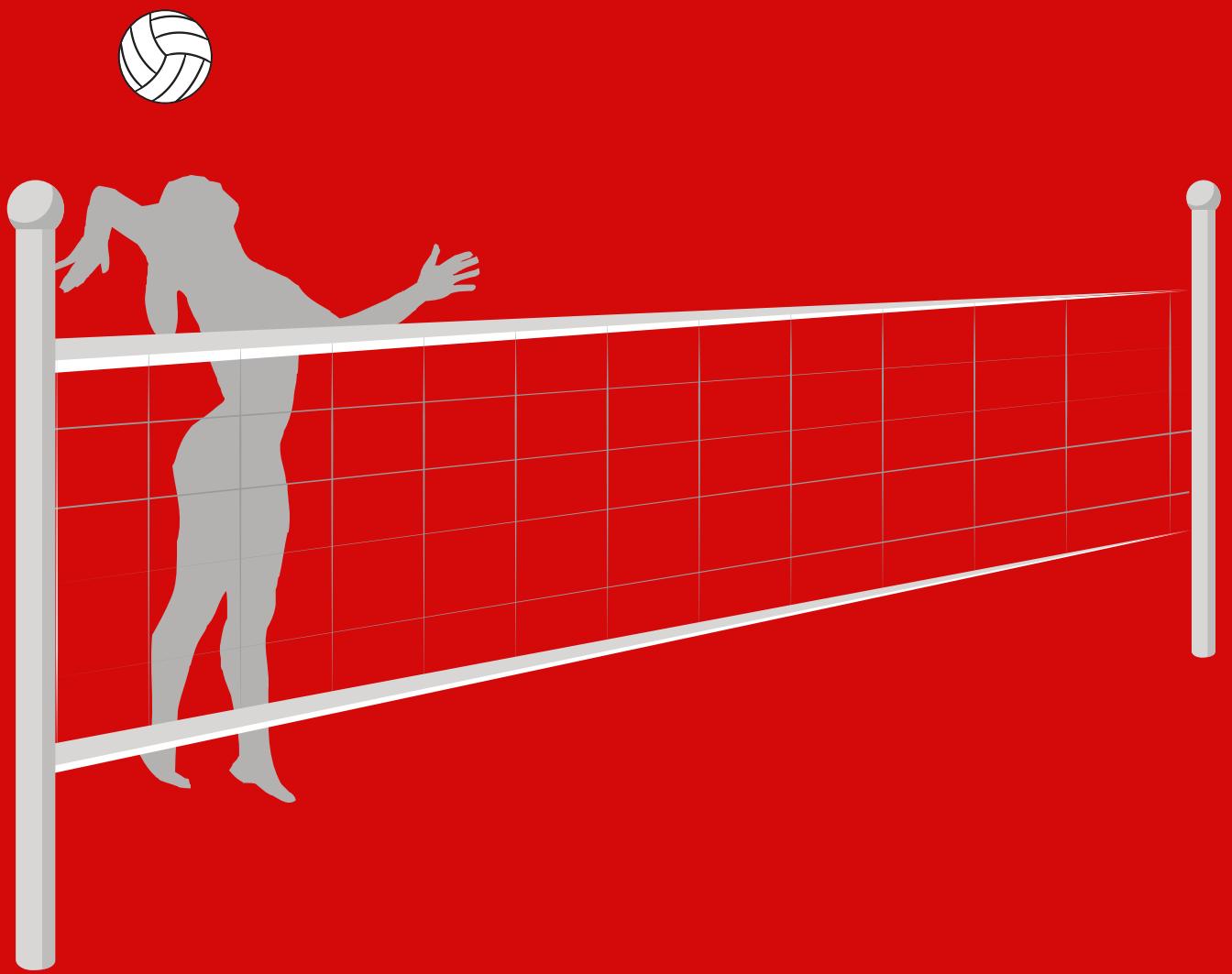
Load management technologies such as Catapult are relatively new in the world of collegiate sports.

Our goal is to merge data and sports science with the art of coaching.

Make data more accessible.

Project Goal

Volleyball coaches can customize each practice to the specific player load goal by knowing the load of each specific drill so they can manage injury risk and optimize performance.



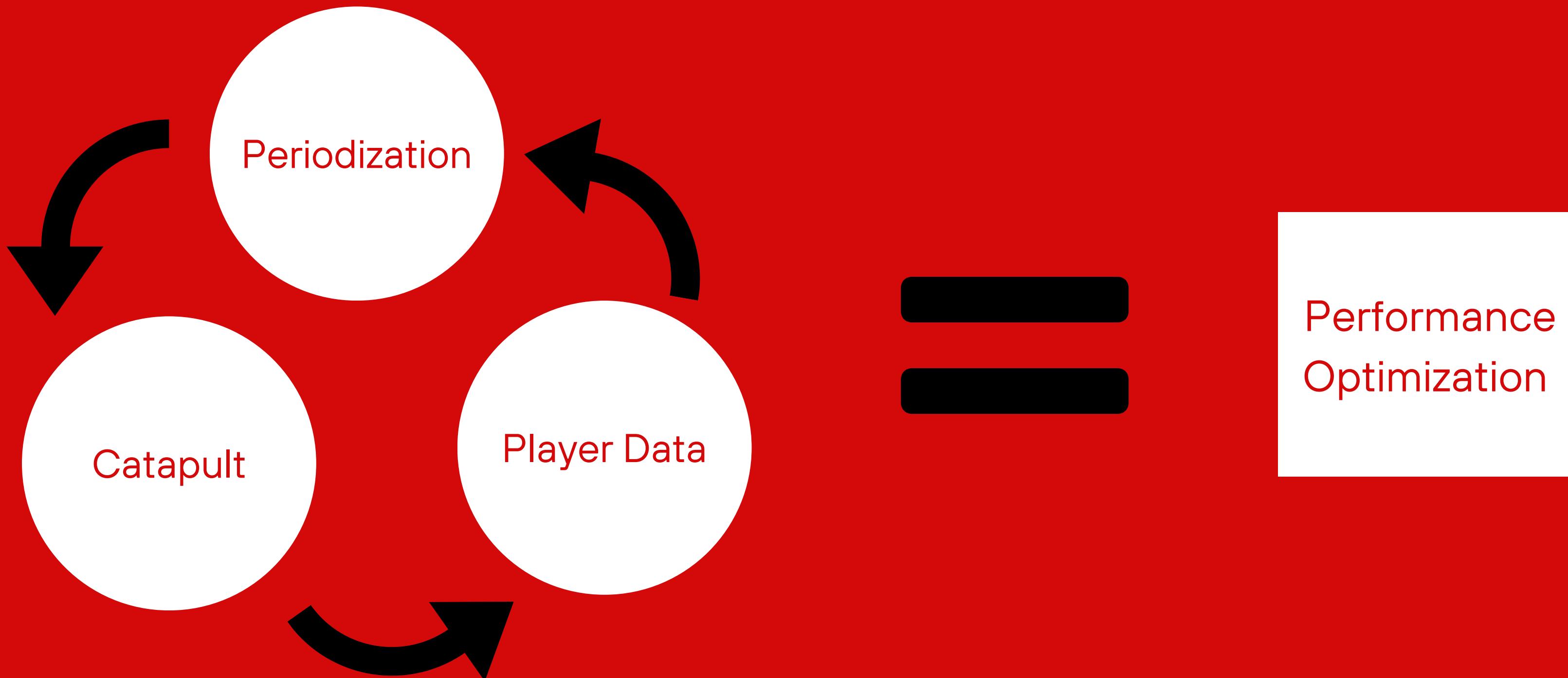
**Where does
the data
come from?**



Player Data Example

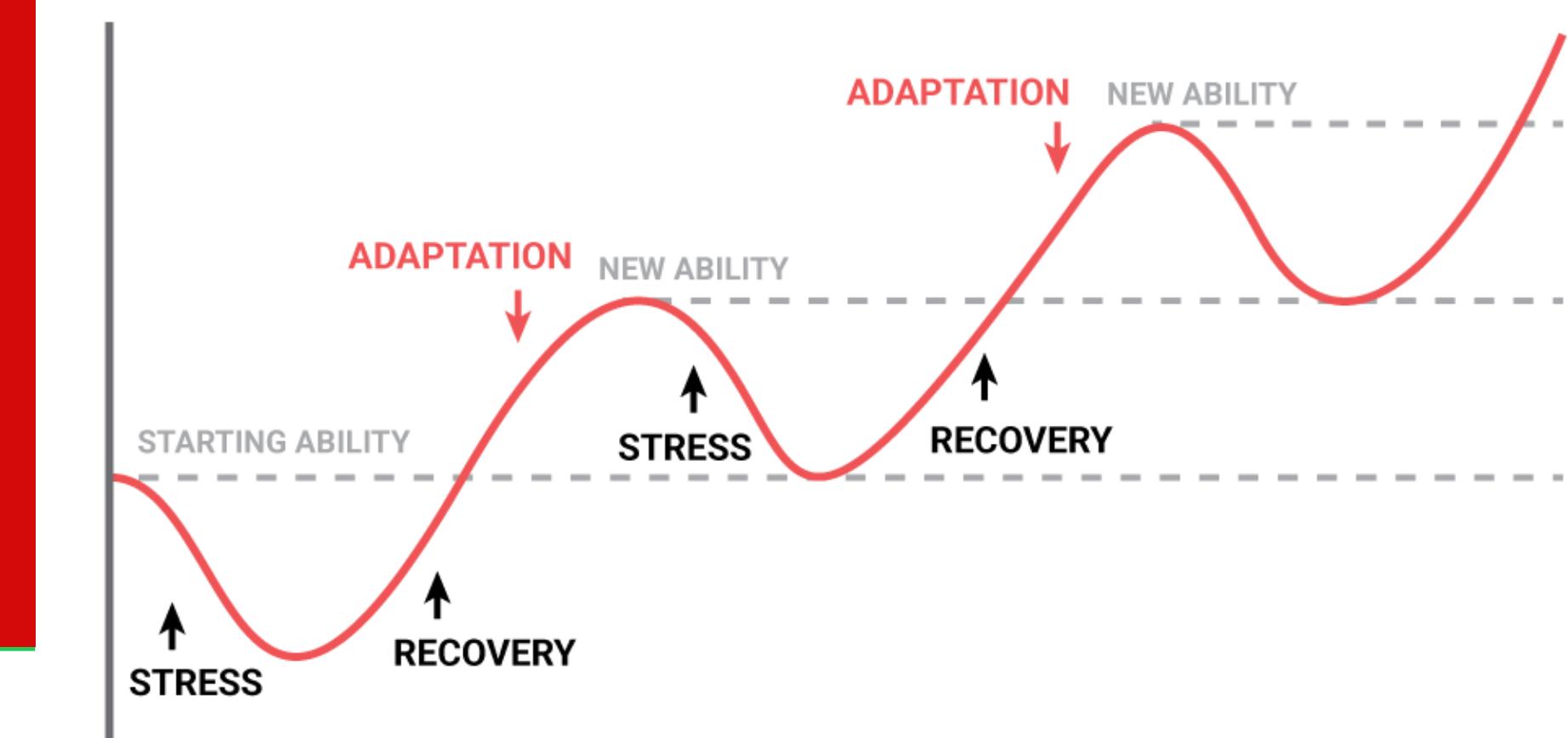
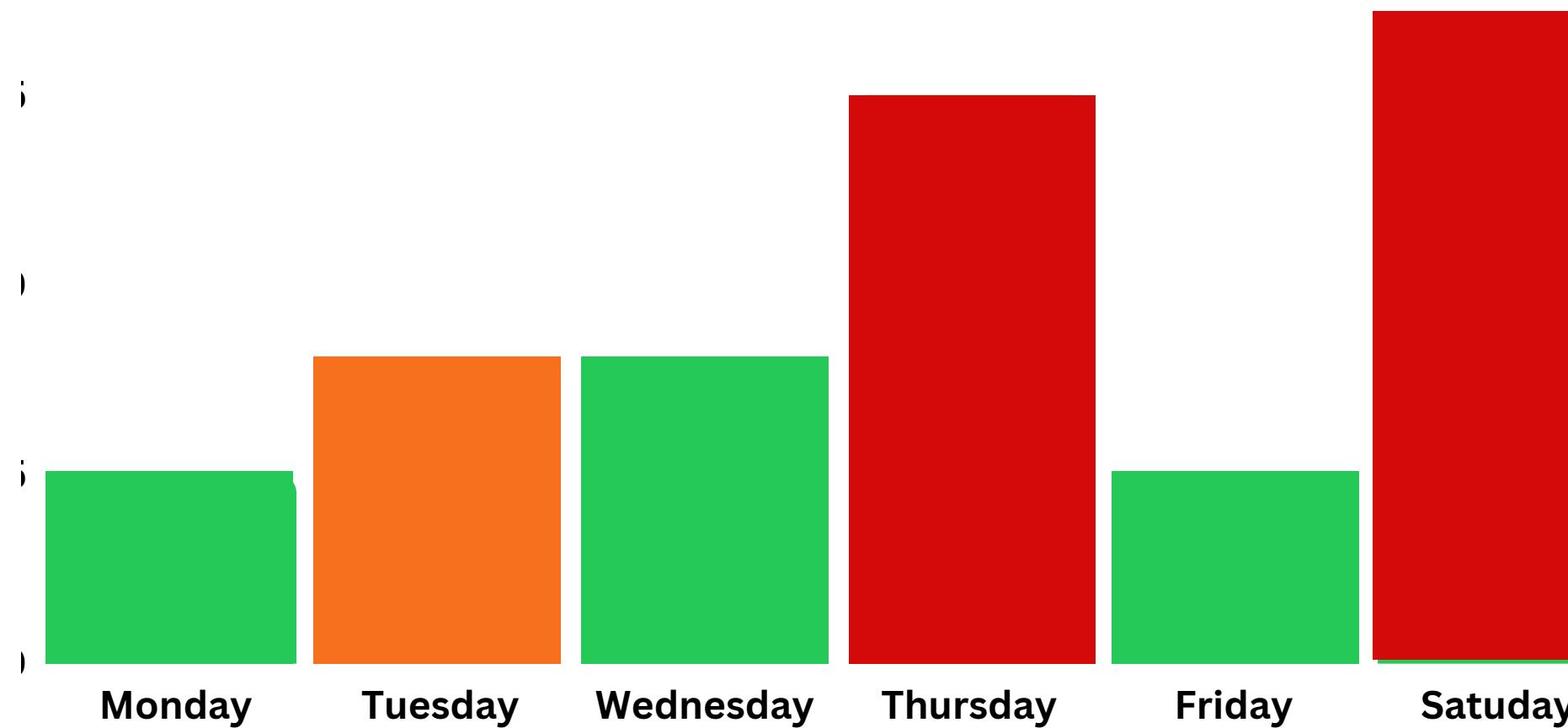
| PERIOD NAME | PLAYER LOAD | PLAYER LOAD PER MIN |
|-------------------------|-------------|---------------------|
| | 167.00 | 12.03 |
| Subrata Paul - 1 | | |
| Q1 | 142.00 | 11.79 |
| Q2 | 320.00 | 15.18 |
| Q3 | 255.00 | 7.86 |
| Q4 | 61.00 | 16.40 |
| Q4 | 57.00 | 8.94 |

Processes



Periodization

Periodization: Periodization is defined as the planned manipulation of training variables (volume, intensity, density) in order to maximize training adaptations and to prevent the onset of overtraining syndrome.



Important Variables

Volume:

**The total
accumulation of
work.**

- Ex. Total Player Load

Intensity:

**The percentage of
maximum for a
specific movement
or activity.**

- Ex. Jump Height

Density:

**The total
accumulation of
work in a set
amount of time.**

- Ex. Player Load Per Minute

How Player Load is Measured

All measured with reference to the body in an anatomical position*

$$\text{Plyr.Load} = \sqrt{\left((fwd_{t+1} - fwd_t)^2 + (side_{t+1} - side_t)^2 + (up_{t+1} - up_t)^2 \right)}$$

01

Medio-Lateral Acceleration* is the sideways acceleration (away from the midline of the body)

02

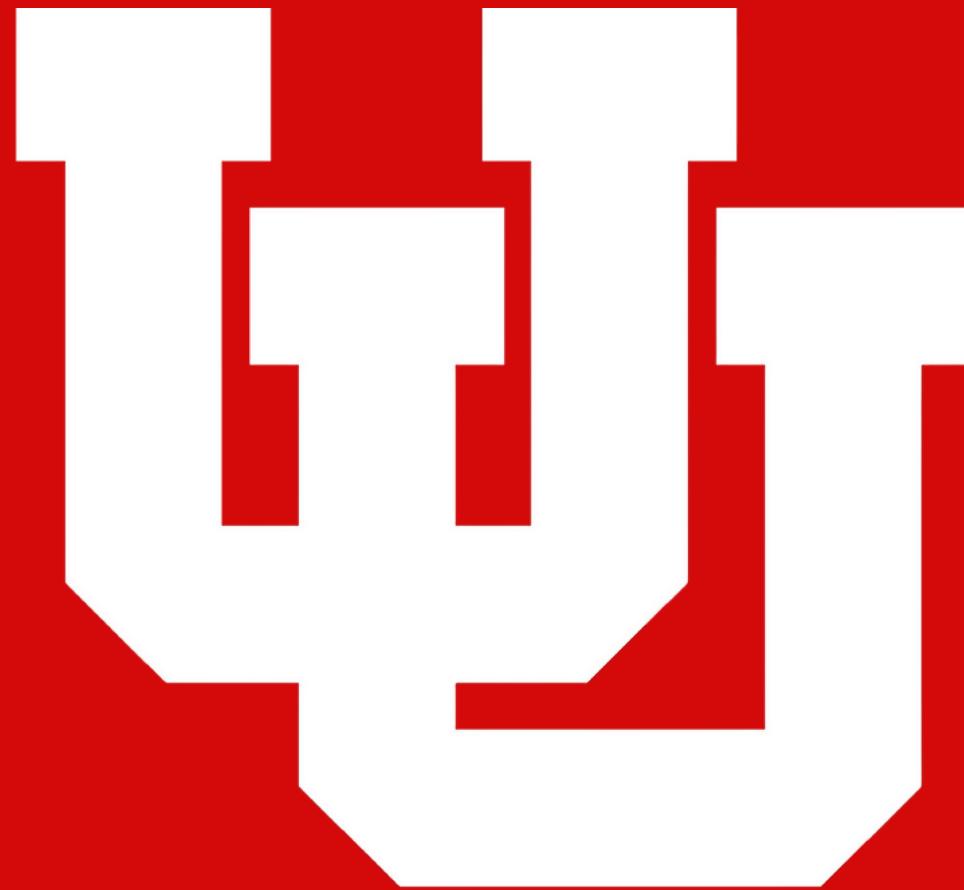
Anterior-Posterior* is the forward acceleration

03

Longitudinal* is the vertical (upwards acceleration)

Part 1 of Our Process

- Practice is made up of different drills
- Drills work on a number of different skills. Ex. Passing, Setting, Blocking, Attacking, Defending.



First Step



Sports Performance Team

Tom - Strength Coach



Coaching Staff

Andrew - Technical Coordinator



Custom Column

Add a column that is computed from the other columns.

New column name

Custom

Custom column formula ⓘ

```
= i { "Dynamic Warm Up", "Warm Up" }, { "Back Row Exchange", "Live Play" }, { "Bounce balls", "Warm Up" }, {"2 Pepper", "Warm Up"}, {"OTP", "Warm Up"}, {"Bumper Ball", "Warm Up"}, {"Bumper balls", "Warm Up"}, {"Tennis", "Warm Up"}, {"Back Row Exchange-For Points", "Live Play"}, {"Extra Skills", "Post Practice"}, {"You're the Women-Outsides", "Attacking"}, {"Utah Sets", "Setting"}, {"Back Row Exchange w Middles", "Live Play"}, {"Passers Technical", "Passing"}, {"Passing & Setting Fund", "Passing"}, {"Setter Technical", "Setting"}, {"You're the Women-Opposite", "Attacking"}, {"You're the Women-Opposites", "Attacking"}, {"You're the Women-Opposites", "Attacking"} ]
```

Learn about Power Query formulas

Available columns

Player Name
Period Name
Period Number
Work/Rest Ratio
Activity Name
Jersey
Unix Start Time

<< Insert

OK

Cancel

✓ No syntax errors have been detected.

| A ^B _C Period Name | A ^B _C Tag | A ^B _C Position Name | A ^B _C Total Player Load |
|---|---------------------------------|---|---|
| Offensive Breakout | Attacking | Setter | 168.97873 |
| Offensive Rotation Games | Attacking | Outside Hitter | 72.54358 |
| You're the Women-Outsides | Attacking | Opposite/ Middle | 16.83194 |
| You're the Women- Middles | Attacking | Setter | 18.95998 |
| Out of System drill | Attacking | Setter | 45.76385 |
| Offensive Rotation Games | Attacking | Setter | 39.37367 |
| You're the Women- Middles | Attacking | Outside Hitter | 14.14334 |
| Hitting Lines | Attacking | Setter | 37.68713 |
| You're the Women- Opposites | Attacking | Opposite/ Middle | 42.77669 |
| You're the Women- Middles | Attacking | Opposite/ Middle | 8.91335 |
| Offensive Breakout | Attacking | Defensive Specialist/Libero | 49.38794 |
| Offensive Roation Games | Attacking | Outside Hitter | 45.98689 |

Part 2 of Our Process



- Drill duration and load vary per drill.
- Our goal was to find the specific player load for each planned drill.
- Finding the load of each drill allows us to customize practice to a target player load we want to hit.
- This helps us with periodization.

Step 2: Emulate Process in R

```
#Combine all csv files
files <- list.files()
df <- do.call(rbind, lapply
  #Remove top 9 rows during merge
  (files, read.csv, as.is=T, skip = 9, header = TRUE))

#Remove all columns except:
df <- df[, c("Period.Name", "Total.Duration", "Total.Player.Load", "Player.Load.Per.Minute", "Position.Name")]
```

```
#Create New Column - Classify Drills
```

```
classify_period <- function(name) {  
  if (name %in% c("Dynamic Warm Up", "Bounce balls", "2 Pepper", "OTP", "Bumper Ball", "Bumper balls", "Tennis", "Warm Up Stations", "2.4 Pepper", "Prepractice warmup", "Bounce Balls",  
    "Match Warm Up", "Bounce Balls 2 4 Pepper", "Warm Up Butterfly", "Warmup Pepper", "Volleyball Match Warm Up", "VB Match Warm Up Bounce Balls", "VB Match Warm Up",  
    "Triangle D Warm Up", "Stations Warmup", "Stationary & Dynamic Warm Up", "Station Warm Up", "Slow Dynamic Warm Up", "Setter Pre Match Reps", "Serving Warm Up",  
    "Pre Match Serving", "Pre Match Serve Pass", "Pre Match Serve", "Pre Match Reps", "Pre Match Pepper", "Pre Match Passing Reps", "Pre Match Passing", "Pre Match Pass Set",  
    "Pre Match Hitting Lines", "Pre Match Extra Passing Reps", "Pre Match Dynamic Warm Up", "Pre Match Extra Passing Reps", "Pre Match Dynamic Warm Up", "Pre Match Dig Set",  
    "Pre Match Bounce Balls", "Over the Net Pepper", "OYO Warm Up", "Neville's Pepper 6 v 6", "Monday 8.29.22 Warm Up", "Middles Pepper", "Match Warm Up Setting",  
    "Match Warm Up Serving+Passing", "Match Warm Up Serving", "Match Warm Up Serve Pass", "Match Warm Up Pepper", "Match Warm Up Passing and Setting",  
    "Match Warm Up Passing & Setting", "Match Warm Up Passing", "Match Warm Up Hitting Lines", "Match Warm Up Hitting LInes", "Match Warm Up Dig+Set",  
    "Match Warm Up Dig Set", "Match Warm Up Dig SEt", "Match Warm Up Crimson Court Back Row Exchange", "Match Warm Up Bounce Balls", "Match Warm Up Attacking",  
    "Match Warm Dig Set", "Match VB Warm Up Serve Pass", "Match VB Warm Hitting Lines", "Match VB Warm Up Bounce Balls + Dig Set", "Match VB Warm Up",  
    "Match Serving", "Match Serve Pass", "Match Pepper", "Pre Match VB Warm Up", "Pre Match Setting Reps", "Pre Match Setters Reps", "Serve Warm Up", "Serve Recieve Warm Up",  
    "Match Bounce Bal", "Match Dig Set", "Match Dynamic Warm Up", "Match Hitting Lines", "2 P Pepper", "2 Person Pepper", "3 Person Ball Control", "4 Corners", "4 Person Pepper",  
    "Ball Control", "Ball Control Warm Up", "Ball Handling Work", "Butterfly", "Cont Hit Pepper", "Dynamic Warmup", "Four Corners", "Pepper", "Pre Match Extra Setting Reps",  
    "Pre Match Setter Reps", "Stations Warm Up", "Match VB Warm Up Hitting Lines", "Warm Up Ball Control")) {  
    return("Warm Up")  
  } else if (name %in% c("Back Row Exchange", "Back Row Exchange-For Points", "Back Row Exchange w Middles", "Situational Wash Table", "Match Play", "Tribond", "2 Point Mini Games", "SR DB",  
    "Brow Exchange", "3 Point Rotations Games Win by 2", "Who Blinks First", "Wash Table- w Subs", "Wash Table 3", "Wash Table 2", "Wash Table - w Subs", "Wash Table",  
    "Two Way Tri Bond", "TriBond", "Trans Attack Point Scoring", "Slap Jack", "Short Court", "Sets to 15", "Mini Games", "SR + DB w Subs",  
    "S+P 2Min. Rounds w MB Approach & Hit", "Rotations- 2", "Rotations with Down Ball", "Rotations -Serve + Down Ball", "Rotations",  
    "Rotational Game Passing Activation 6s", "Rotation game reverse scoring with MB activation", "Rotation Points Play", "Rotation Points",  
    "Rotation Games Reverse Scoring w MB activation", "Rotation Games Passing Activation 6's", "Rotation Games", "Rotation Game reverse score",  
    "Rotation Game", "Red Zone Games with Subs", "Red Zone Games", "Queens +1", "Serve Receive Rotations w Hitting", "Over on 2", "Over in 2 Oos",  
    "Over in 2", "Over In 2", "Old School Volleyball", "Old School Scoring plus Bonus Ball", "Matrix", "1 V 1 Short Cout", "1 v 1 Short Court", "15 Point Game",  
    "1v1v1", "2 Point Mini Games Old School Scoring", "2 Way Wash", "2 Way Wash Table", "2 v 2 Short Court", "2v2", "2v2 Short Court", "4 v 4 wit alley", "5 V 5",  
    "5 v 5", "5v5", "6 Rotation Games w Setters Rotating", "6s MB Kill first Ball 2nd ball FBT", "6v6 Overload", "6 Rotation Games w Seters Rotating", "BR Exchange",  
    "BSBH Over in 2", "Back Row Exchange 3 Point Mini Games", "Back Row Exchange Middles Activated", "Back Row Exchange by Rotation",  
    "Back Row Exchange w MBs", "Backrow Exchange", "Bic to Pin Exchange", "Bic to Pin Exchange drill", "Bingo", "Darts", "DiBond", "End Zone Rotations",  
    "First Ball Kill w Subs", "Gauntlet", "Gauntlet w Subs", "Guantlet", "Guantlet w Subs", "Half Court 1 v 1", "Half Court Doubles",  
    "Back Row Exchange 3 Point Mini Game", "Mini games", "Over in 2 OoS", "Pass Hit + Bic", "Rotation 6 work", "Rotation Games Reverse Scoring w MB activation",  
    "Rotations- w Subs", "Set to 15", "Tri Bond", "3 v 6 Defensive Stops", "DiBiond")) {  
    return("Live Play")  
  }  
}
```

```
# Use mutate() and the classify_period() function to create the new column  
df <- df %>%  
  mutate(Period.Type = sapply(Period.Name, classify_period))
```

Grouped & Averaged Data:

```
library(data.table)

#Change Duration to Time

df$Total.Duration <- as.ITime(df$Total.Duration)

#Group Drills

grouping <- aggregate(cbind(df$Total.Player.Load, df$Player.Load.Per.Minute), by = list(df$Period.Name, df$Period.Type), FUN = mean)

colnames(grouping) <- c("Drill", "Tag", "Player.Load", "Player.Load.Per.Minute")

duration <- df$Total.Duration[!duplicated(paste(df$Period.Name, df$Period.Type))]

#Add back duration column

grouping$Duration <- duration

print(grouping)

#Change Datatypes

grouping$Drill <- as.character(grouping$Drill)
grouping$Tag <- as.character(grouping$Tag)
```

Step 3: Created App

```
library(shiny)
library(dplyr)
library(jsonlite)
library(knitr)
library(shinythemes)
```

Loaded Libraries

```
ui <- fluidPage(
  titlePanel("Practice Planner"),
  tags$style(HTML(
    body {
      background-color: #000000;
      color: white;
    }
    .well {
      background-color: #CC0000;
      border-color: #000000;
    }
  )),
  sidebarLayout(
    sidebarPanel(
      sliderInput("duration", "Duration (min)", min = 0, max = 60, value = 30),
      selectInput("tag", "Tag", choices = c("Passing", "Live Play", "Warm Up",
                                         "Post Practice", "Attacking", "Setting", "Defense", "Match Play",
                                         "Serving", "Pre Practice", "Blocking"), selected = "Passing"),
      selectInput("selected_drill", "Select a Drill", choices = NULL),
      actionButton("add_drill", "Add to Schedule"),
      br(),
      br(),
      actionButton("remove_drill", "Remove from Schedule"),
      h4("Drill Schedule:"), 
      tableOutput("drill_schedule")
    ),
    mainPanel(
      h4("Estimated Player Load Per Drill:"), 
      verbatimTextOutput("estimated_player_load")
    )
  )
)
```

Calculated PL/M * Duration

```
# Reactive expression to calculate player load
player_load <- reactive({
  if (!is.null(input$selected_drill) && input$duration > 0) {
    grouping %>%
      filter(Drill == input$selected_drill, Tag == input$tag) %>%
      mutate(`Estimated Player Load` = Player.Load.Per.Minute * as.numeric(input$duration)) %>%
      select(Drill, `Estimated Player Load`)
  } else {
    data.frame(Drill = character(), `Estimated Player Load` = numeric())
  }
})

#Calculate output based on filters applied by user
output$estimated_player_load <- renderPrint({
  if (input$duration > 0) {
    estimated_data <- grouping %>%
      filter(Tag == input$tag,)          Added 'Filters' Here
    estimated_data <- estimated_data %>%
      mutate(`Estimated Player Load` = Player.Load.Per.Minute * as.numeric(input$duration)) %>%
      select(Drill, `Estimated Player Load`)

    knitr::kable(estimated_data)
  } else {
    "Duration must be greater than zero."
  }
})
```

Displayed Output

```
observeEvent(input$selected_drill, {
  pl <- player_load()
  if (nrow(pl) > 0) {
    output$selected_drill_player_load <- renderPrint(knitr::kable(pl))
  }
})

observeEvent(input$add_drill, {
  if (!is.null(input$selected_drill)) {
    new_drill_row <- data.frame(Drill = input$selected_drill, Duration = input$duration, `Estimated Player Load` = player_load()$`Estimated Player Load`)
    drill_schedule_data <- drill_schedule()
    new_drill_schedule_data <- rbind(drill_schedule_data, new_drill_row)
    drill_schedule(new_drill_schedule_data)
  }
})

# Remove selected drill from drill schedule
observeEvent(input$remove_drill, {
  if (!is.null(input$selected_drill)) {
    drill_schedule_data <- drill_schedule()
    new_drill_schedule_data <- drill_schedule_data[!drill_schedule_data$Drill %in% input$selected_drill, ]
    drill_schedule(new_drill_schedule_data)
  }
})

# Display drill schedule
output$drill_schedule <- renderTable({
  drill_schedule()
}, include.rownames = FALSE)

# display w/ default values
outputOptions(output, "estimated_player_load", suspendWhenHidden = FALSE)

}

shinyApp(ui, server)
```



What does it
look like and
how does it
work?

Problems We Faced



01

Many drills to categorize, some drills fall under 2 different categories.

02

Drill names are often entered inconsistently. This required data cleaning.

03

Data doesn't automatically update yet and does not include other important Catapult metrics.

Next Steps



Connect to a dynamic data source.

Add total row under drill scheduler

Collaborate Further with Volleyball Staff

Clean Data - Drill names that have been repeated from Catapult

Add Additional Datapoints to the App



QUESTIONS