**Longitudinal Data Analysis**

**With focus on Repeated Measures ANOVA**

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**Example:**Suppose you’ve been roped into coming up with a way to analyze and quantify the healing process of typical wrist fractures using high-resolution CT. This is a new field of study, so your goal is to hypothesize and validate which measurable parameters show significant change during the healing process. Each participant’s fractured wrist is scanned multiple times during healing, and the opposite non-fractured wrist is also scanned to represent the pre-fractured state of the bone. Very quickly you realize this is a longitudinal study and t-tests simply won’t do the trick… at the very least you’ll need to run a repeated measures ANOVA.

To date you’ve scanned the fracture region of **5 participants at the intervals shown below**. **You hypothesize that bone mineral density will change over time** as the bone transitions through callus formation, callus mineralization, then finally bone remodeling.

Below is the graph of your data, which looks promising, but *are these changes statistically significant*.

Below is the data table summarizing the study

**Table 1: Bone Mineral Density results for the first 5 participants of a fracture-healing study**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Bone Mineral Density [mg HA/cm3] | | | |  |  |
| StudyID | Baseline | 2 Weeks | 4 Weeks | 6 Weeks | Subject Averages |  |
| DRF\_001 | 197 | 195 | 225 | 201 | 205 |  |
| DRF\_003 | 248 | 287 | 294 | 277 | 276 |  |
| DRF\_004 | 239 | 246 | 242 | 222 | 237 |  |
| DRF\_005 | 238 | 266 | 278 | 273 | 264 |  |
| DRF\_006 | 244 | 280 | 285 | 283 | 273 |  |
| Time-Point Averages | 233 | 255 | 265 | 251 | 251 | Grand Average |

**Table 2: A Somewhat Standard ANOVA Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Degrees of freedom** | **Sum of Squares** | **Mean Squares** | **F-ratio** | **p-value** |
| Between Times |  |  |  |  |  |
| Within Times |  |  |  |  |  |
| Within Subjects |  |  |  |  |  |
| Error  (unexplained variance) |  |  |  |  |  |

**Table 3: Effect Size:**

|  |  |  |
| --- | --- | --- |
| Effect Size Metric | Formula | Example Value |
| Partial Eta Squared |  |  |
| Omega Squared |  |  |