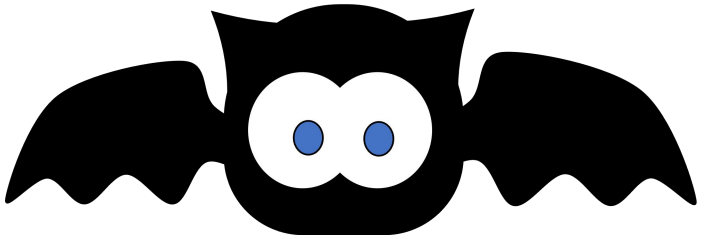
WPI



BATS: Development of a Biosignal Analysis Toolkit and Pipeline for Polytrauma Research

Nathan Draudt (BME), Claire Nicolas (BME),
Carlos Velasquez (CS), Lauren Wasserman (CS)

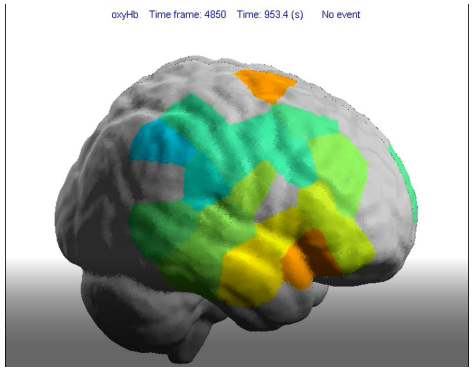
Contents

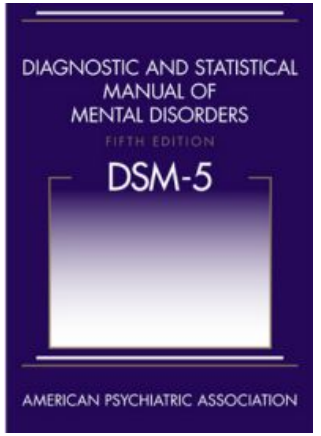
Background: What is Polytrauma?

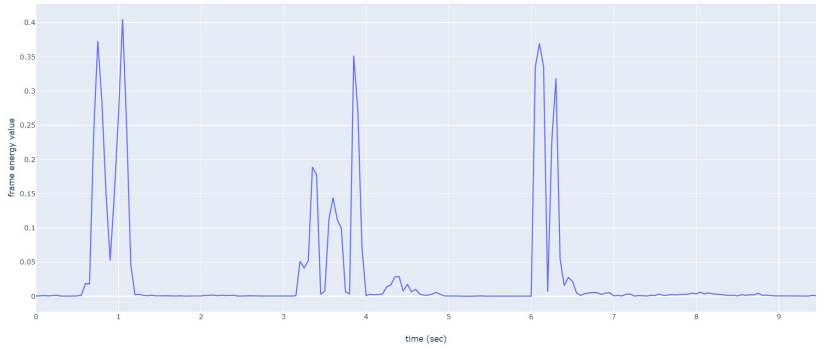
– Comorbidities

- Post Traumatic Stress Disorder (**PTSD**)
- Major Depressive Disorder (**MDD**)
- Generalised Anxiety Disorder (**GAD**)
- Chronic Pain
- Postconcussive Syndrome (**PCS**)

– Diagnosis







Need Statement

A way to improve data analysis and data storage for polytrauma researchers to facilitate multifaceted polytrauma research.

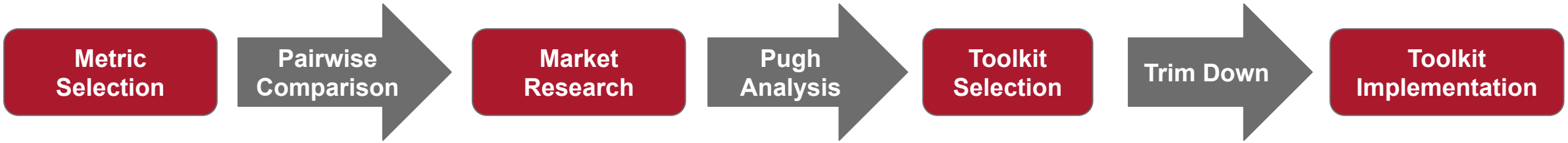
Goals

Develop a web-based pipeline that allows for the simultaneous analysis of biosignals and psychiatric evaluations to facilitate multifaceted polytrauma research.

Design Process: Needs

- **Primary Stakeholders:** Researchers using BATS
- **Their Needs:**
  - Creative freedom to complete whatever analysis they choose
  - Have easy to read signal processing
  - Create biomarkers
  - Works with Matlab & Python code
- **General Needs:**
  - Create multi-signal analysis for easy diagnosis & tools
  - Save biodata in an online easily accessible database
  - Process data with biosignal algorithms and statistical tools within the tool
  - Allow for saving and reprocessing of datasets

Design Process: Algorithm Development

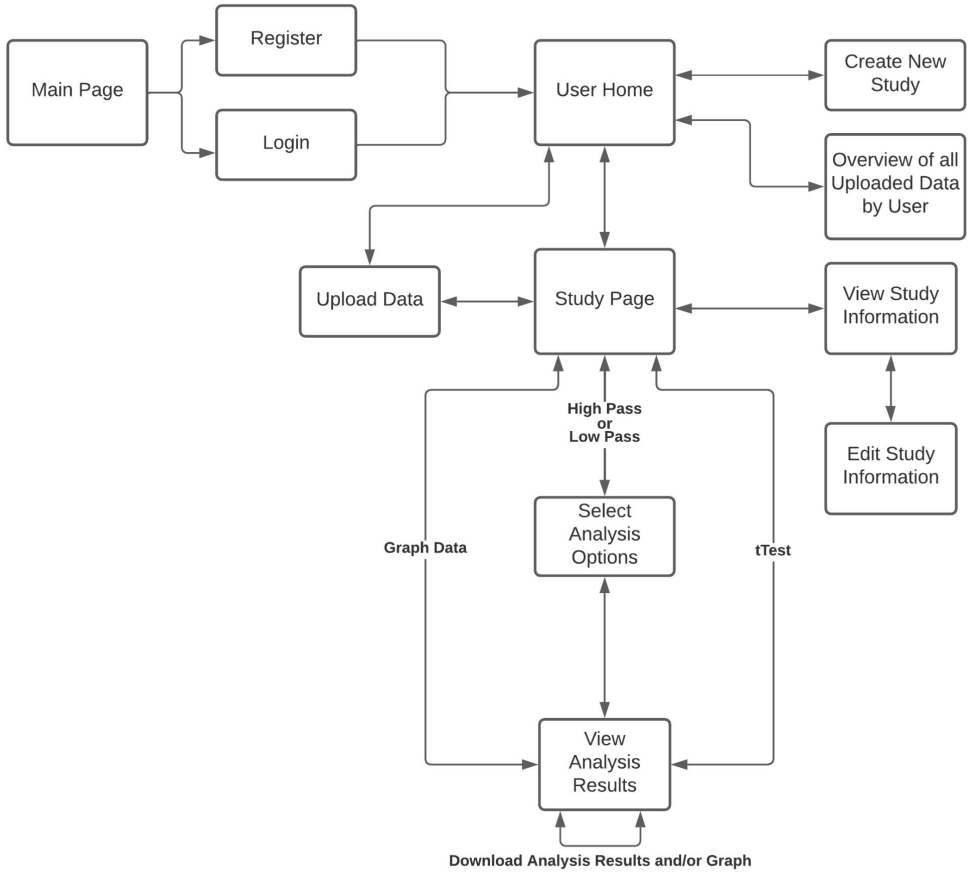


	Open Source	Easy Structure	Visualisation	Noise Reduction	Python	Java	Weighting
Open Source	x	1	1	1	1	1	5
Easy Structure	0	x	1	1	0	0	2
Visualisation	0	0	x	0	0	0	0
Noise Reduction	0	0	1	x	0	0	1
Python	0	1	1	1	x	0	3
Java	0	1	1	1	1	x	4

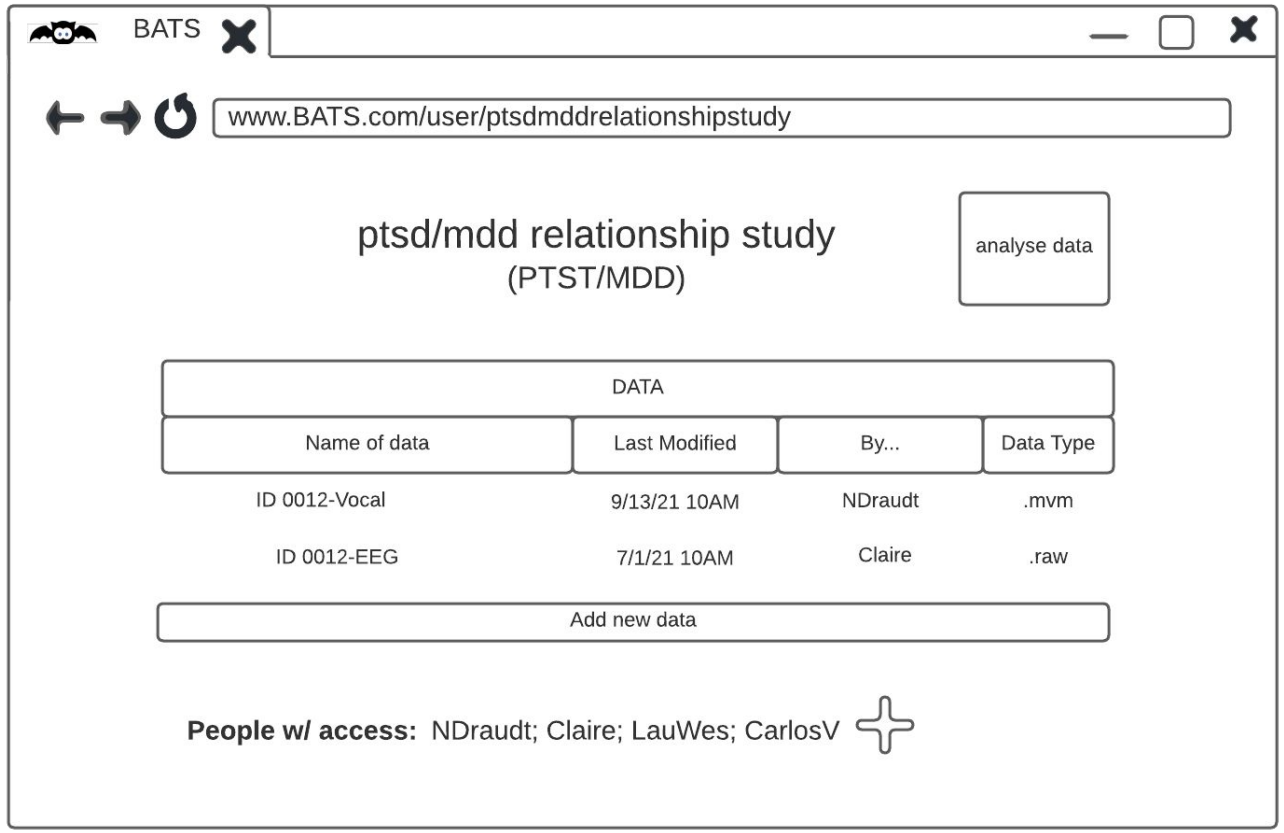
Table 1: Pairwise Comparison Chart for Toolkit Development

Design Process: System Development

Prototype 1: Flow Diagram



Prototype 2: Low Fidelity BATS Study Page



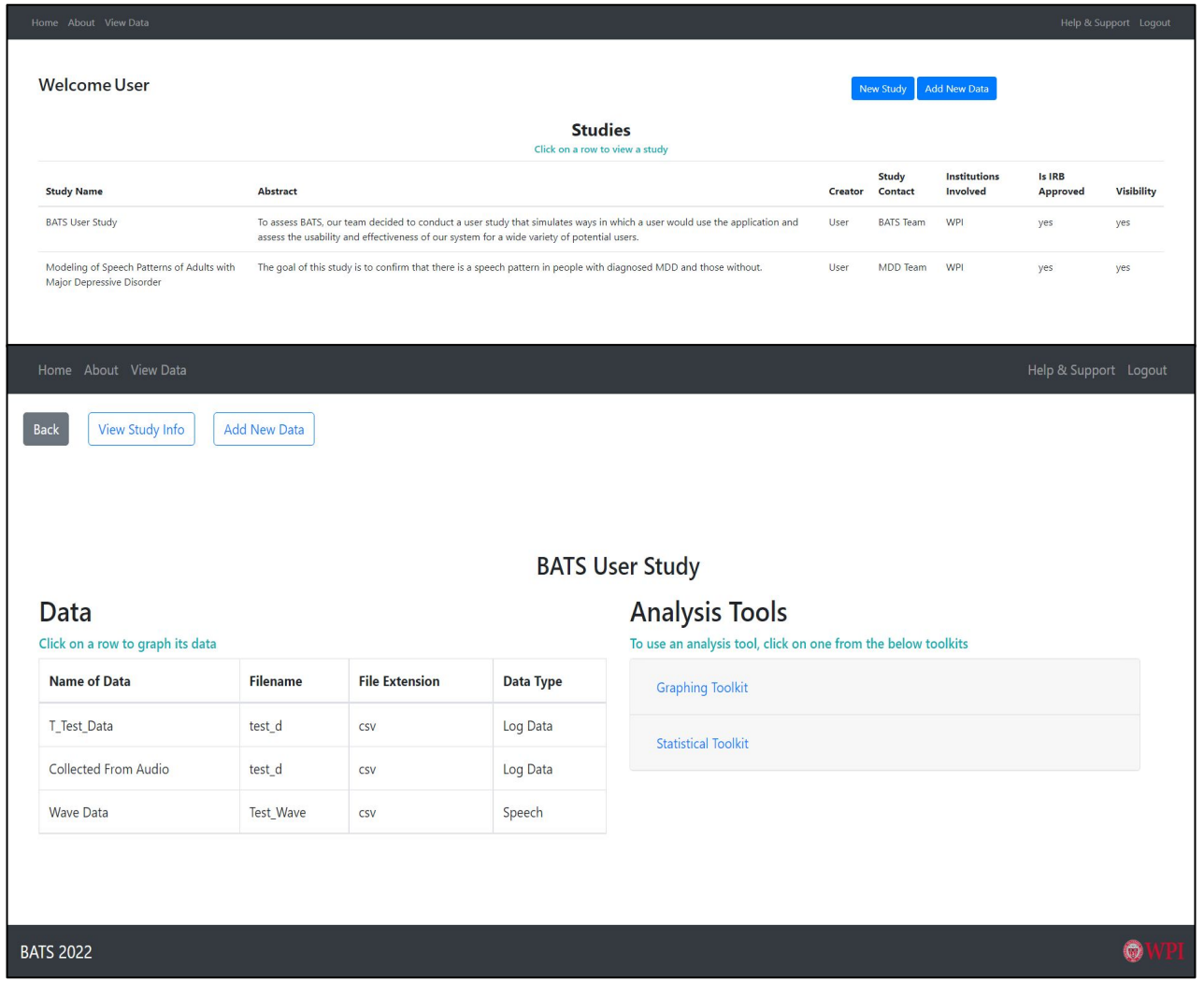
BATS: Technology

Backend

Frontend

BATS: Login & Registration

BATS: Final System



BATS: Uploading New Data

BATS: Available Analysis Tools

Graphing Toolkit

Name	Description	For File Type	For Data Type
Graph CSV Data	Produces a graph from .csv data.	.csv	All
High Pass Filter	Filters out unwanted low frequencies.	.csv	All
Low Pass Filter	Filters out unwanted high frequencies.	.csv	All

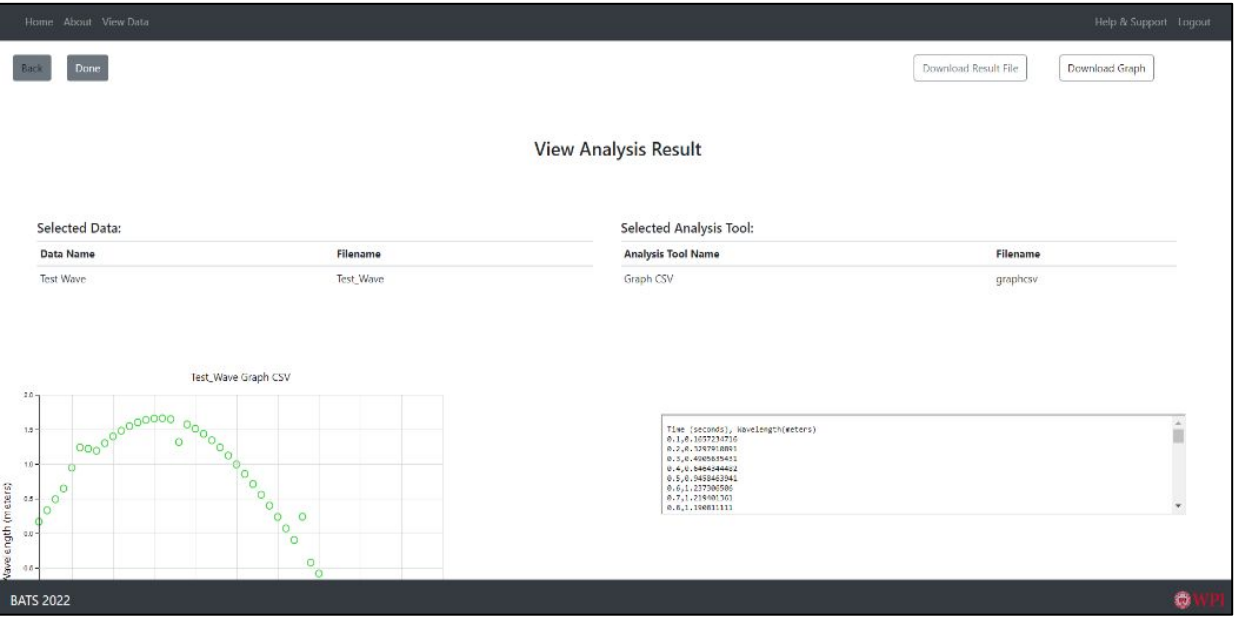
Statistical Toolkit

Name	Description	For File Type	For Data Type
tTest	Determines if there is a statistical different between the mean of two groups.	.csv	All

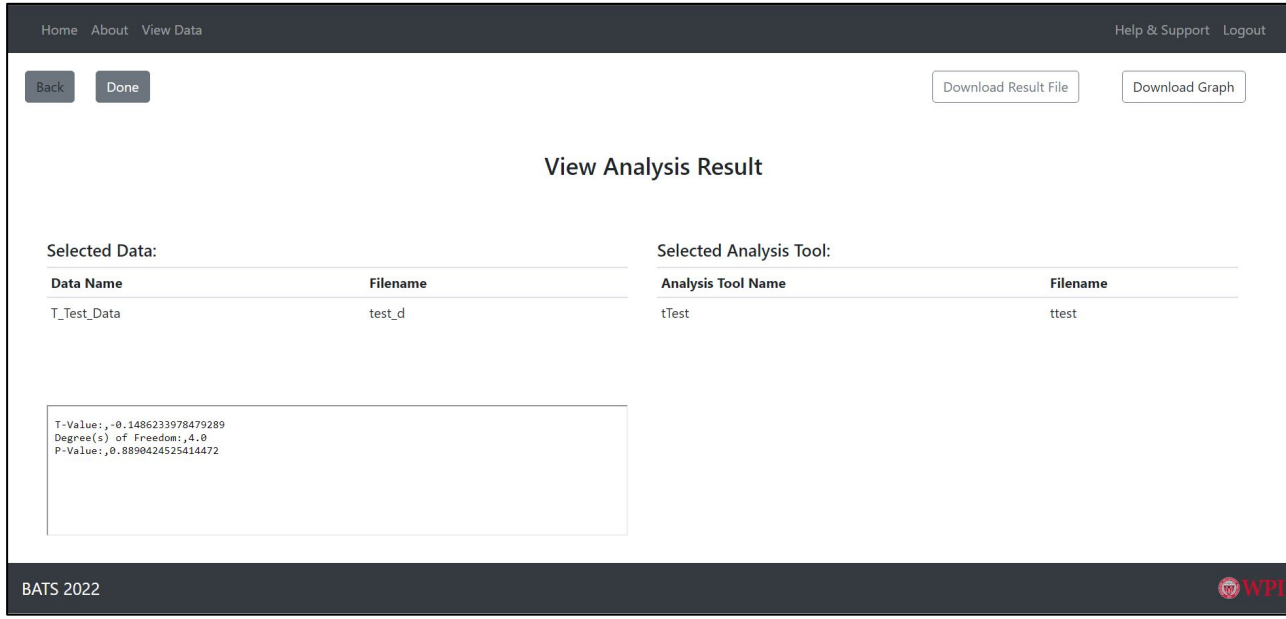
BATS: Analysis Results

BATS: Final System (Continued)

Analysis Results



Graph CSV



tTest

BATS: Final System (Continued)

Prototype analysis toolkits

BATS: User Home & Study Page

Verification & Validation Testing

User Stories:

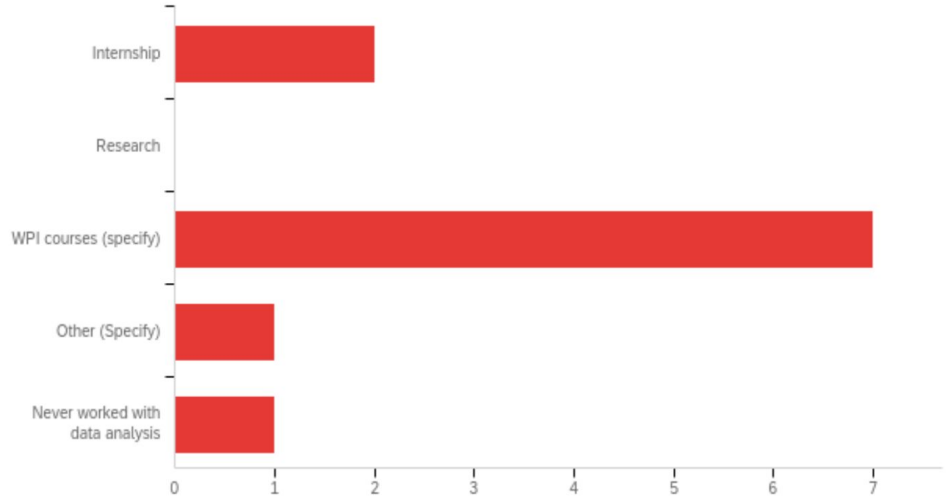
- Confirms system's ability to complete various activities
- Follows a hypothetical user via written narrative
- Tested:
  - Account Creation
  - Data uploading
  - Analyzing data
  - Analysis viewing
  - Downloading data

User Study:

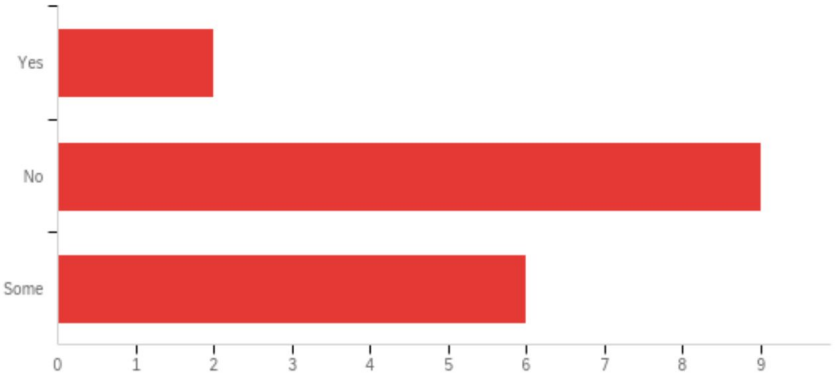
- IRB approved
- Think-aloud and interview
- Scenarios:
  - Scenario 1:
    - Account creation
    - Study creation
    - Upload data
  - Scenario 2:
    - Graph data
  - Scenario 3:
    - Analyse data with tool
    - Downloading
- Interviews between each scenario

User Testing: Demographics

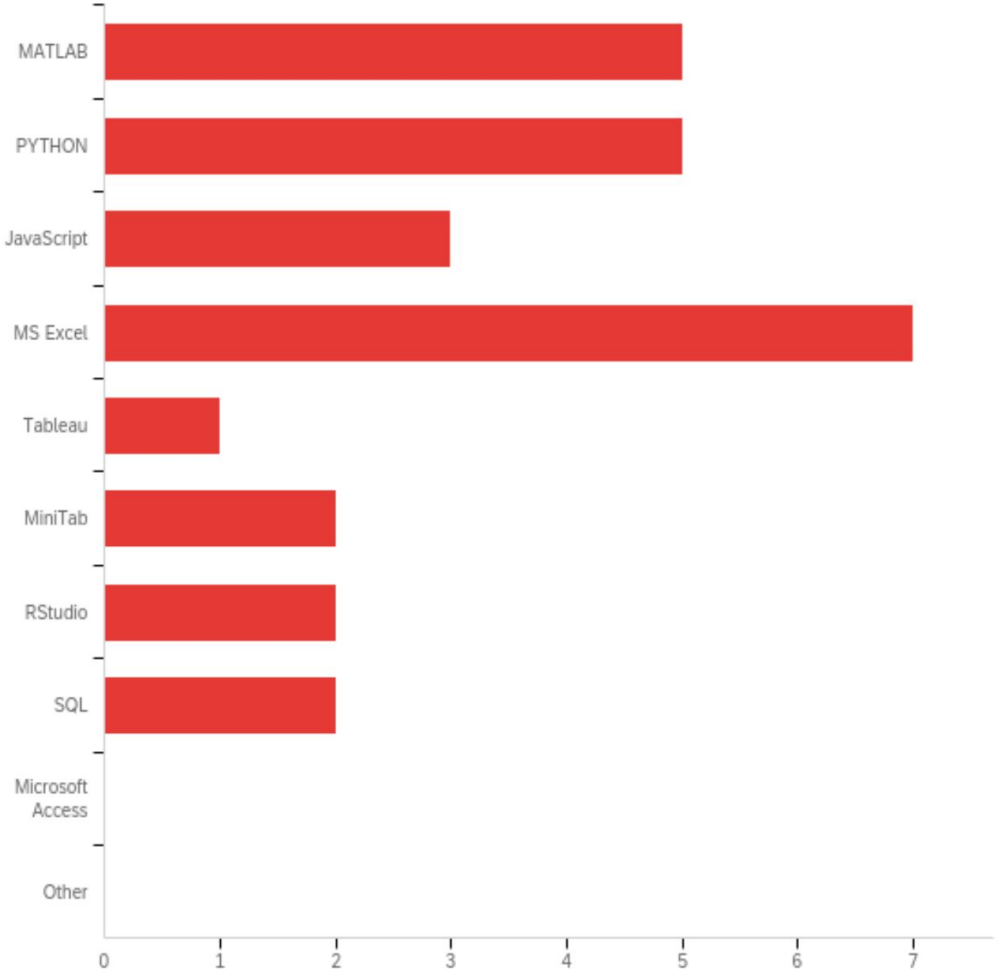
In what environment have gained your data analysis experience?



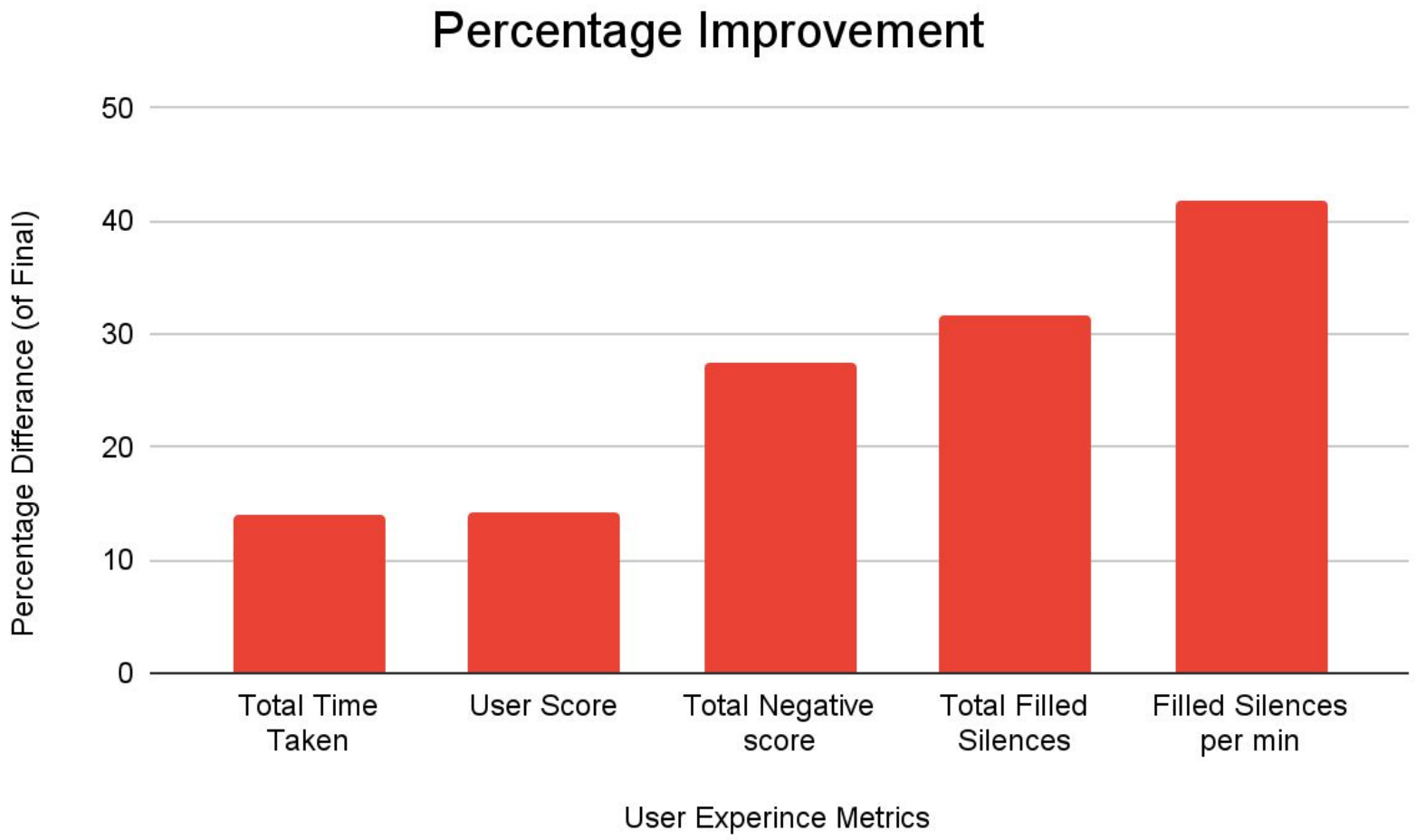
Do you have experience in data analysis?



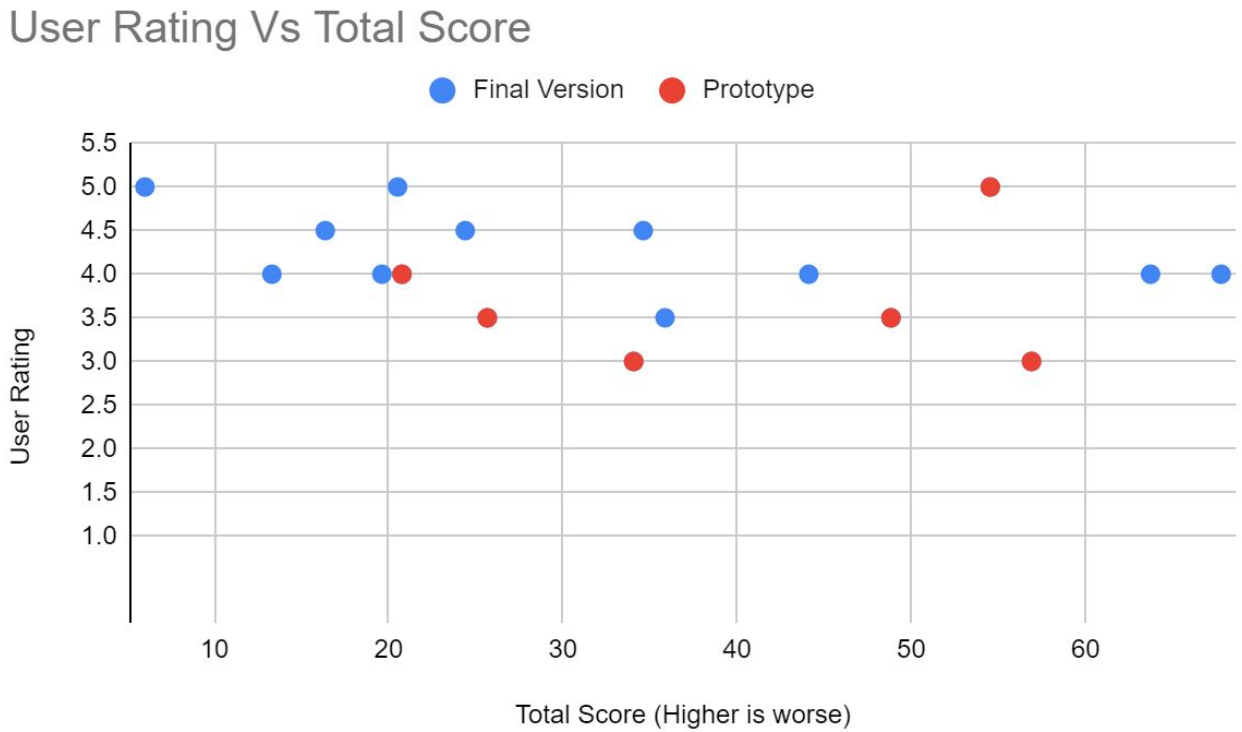
Which of the following tools do you have experience with?



General Overview of Results

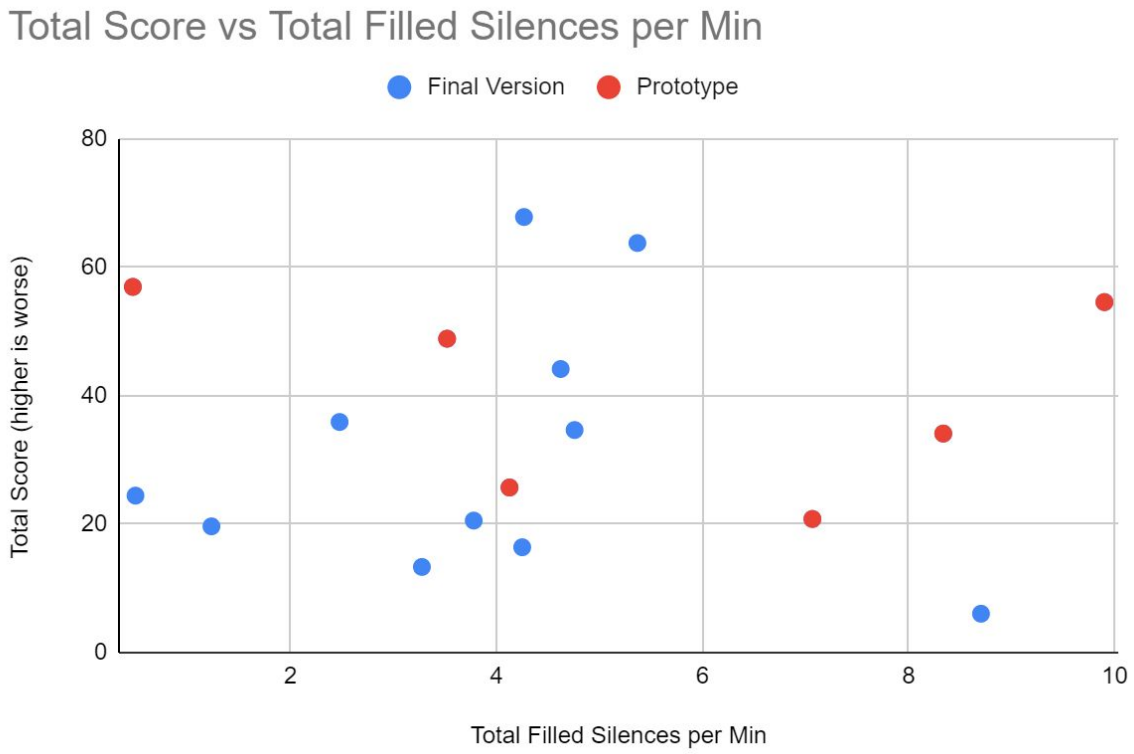


User Testing Results: Usability Score vs TNS



- Total Negative Score = time taken + 4(num questions asked)+ 10(num tasks failed)
- User score= user ranking of the system [1 , 5]
- r(9)=-0.511 p=0.0539
- Users ranked the system low when they failed more

User Testing Results: Filled Silences



- Research shows that filled silences (um, ahh) correlate with higher mental load
- A positive correlation between Filled silenced per minute and Total Negative score would indicate successful use of these metrics
- With a correlation test result of r(8)=0.509 p=0.0663

Conclusion

- Functioning System Objectives
- User friendly (Improvements upon Prototypes)
- Interdisciplinary Learning
- Foundation for Future Works

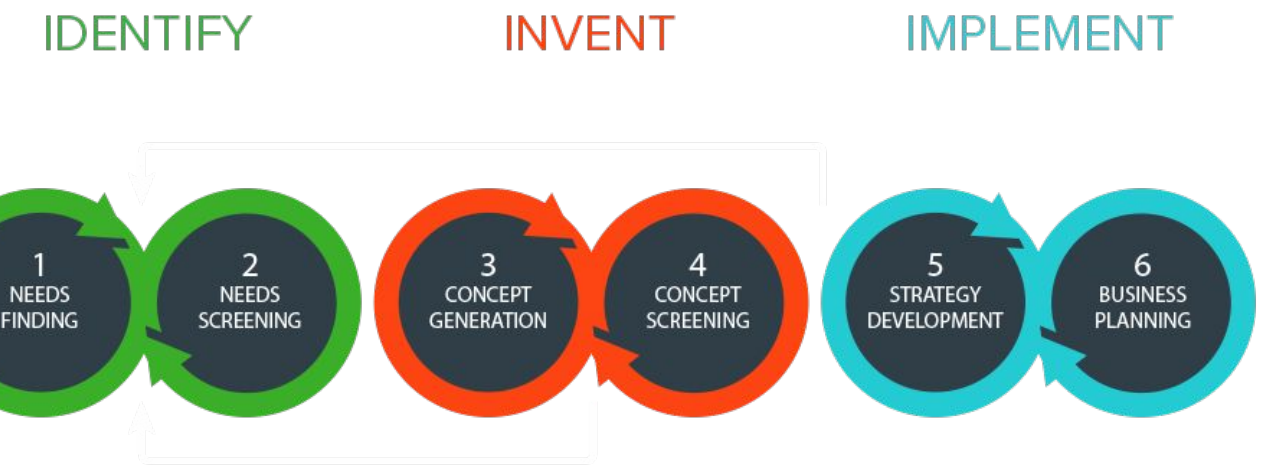
Acknowledgments

- We would like to thank our advisors:
  - Adam Lammert
  - Mark Claypool
- Dr. Jean King, Anna Bean, Alicia Howell-Munson amongst others.
- The people who participated in our user study.

Learn more

To view our bibliography, learn more about the system, and watch BATS in action, please scan the QR code.

Layout: Two Content



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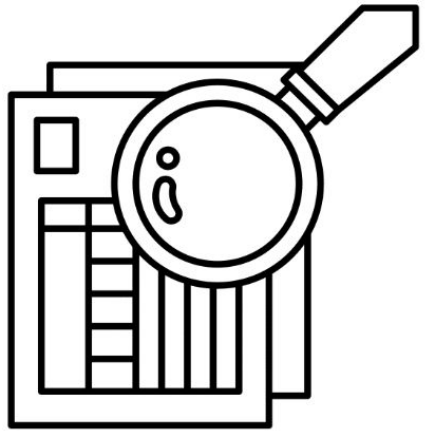
- Line spacing 0.95, before paragraph 10pt
-
-
- et color is



ullet

Layout: Title and Content Verdana Bold 32pt

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- Left justified
- Sentence case
- First level bullet color is accent1
  - Second level bullet Verdana 20pt
  - Line spacing 0.95, before paragraph 6pt
    - Third level
    - Third level
      - Fourth level

Color Scheme

White–Background
R255 G255 B255

Black
R0 G0 B0

Red
R171 G25 B45

Grey
R109 G109 B109

Accent 1
R171 G25 B45

Accent 2
R178 G183 B187

Accent 3
R44 G106 B140

Accent 4
R183 G160 B121

Accent 5
R70 G160 B220

Accent 6
R109 G109 B109

Contents

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- Line spacing 0.95, before paragraph 12pt
- Left justified
- Sentence case
- First level bullet color is accent1
  - Second level bullet Verdana 20pt
  - Line spacing 0.95, before paragraph 6pt
    - Third level
    - Third level
      - Fourth level

Default Settings

Theme Fonts:
Verdana (heading)
Verdana (body)

Text Box Default:
Verdana 16pt
Color: Black
Align: Center
Line Spacing: Multiple .95
Space Before: 6pt

For labels only – use layout placeholders for bulleted lists

Drawing Style Default:

Line Style Default:

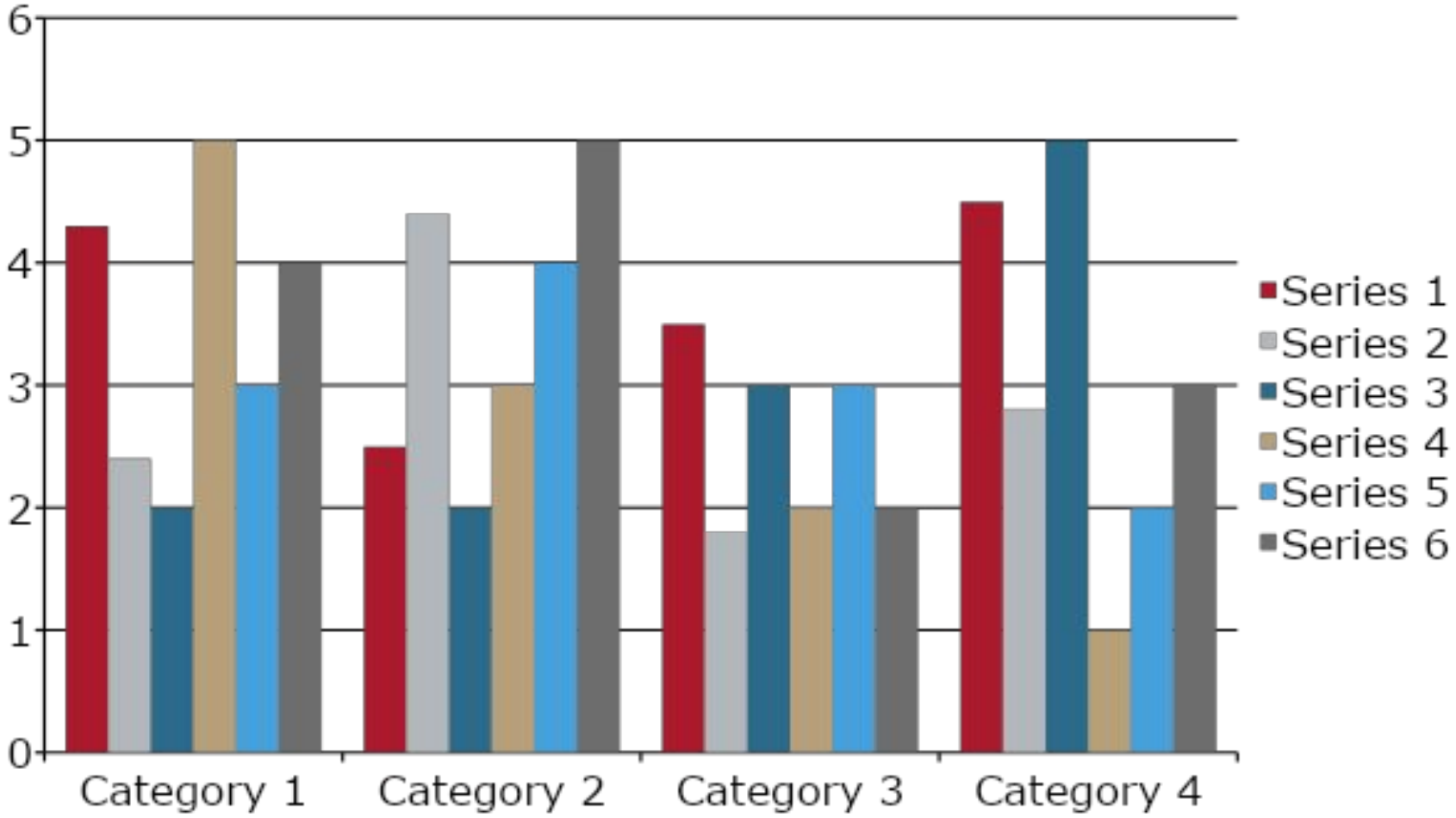
Default Table Style

Heading 1	Heading 2	Heading 3	Heading 4	Heading 5
Content	Content	Content	Content	Content
Content	Content	Content	Content	Content
Content	Content	Content	Content	Content
Content	Content	Content	Content	Content

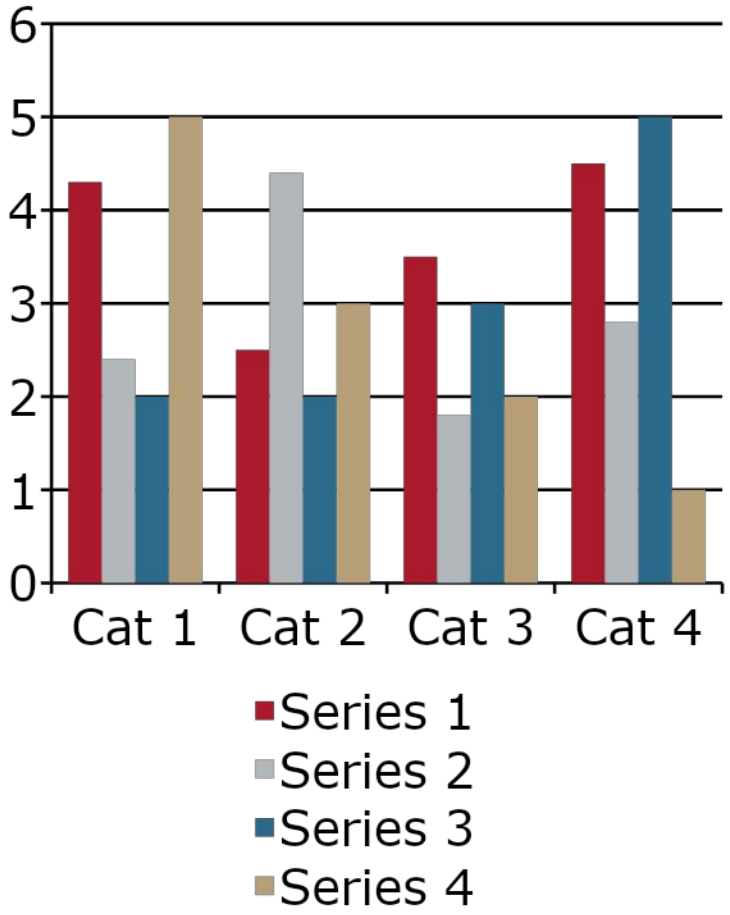
Layout: PhotoCaption

Photo description

Layout: Content
Column Chart Sample



Layout: Two Content Column Chart Sample



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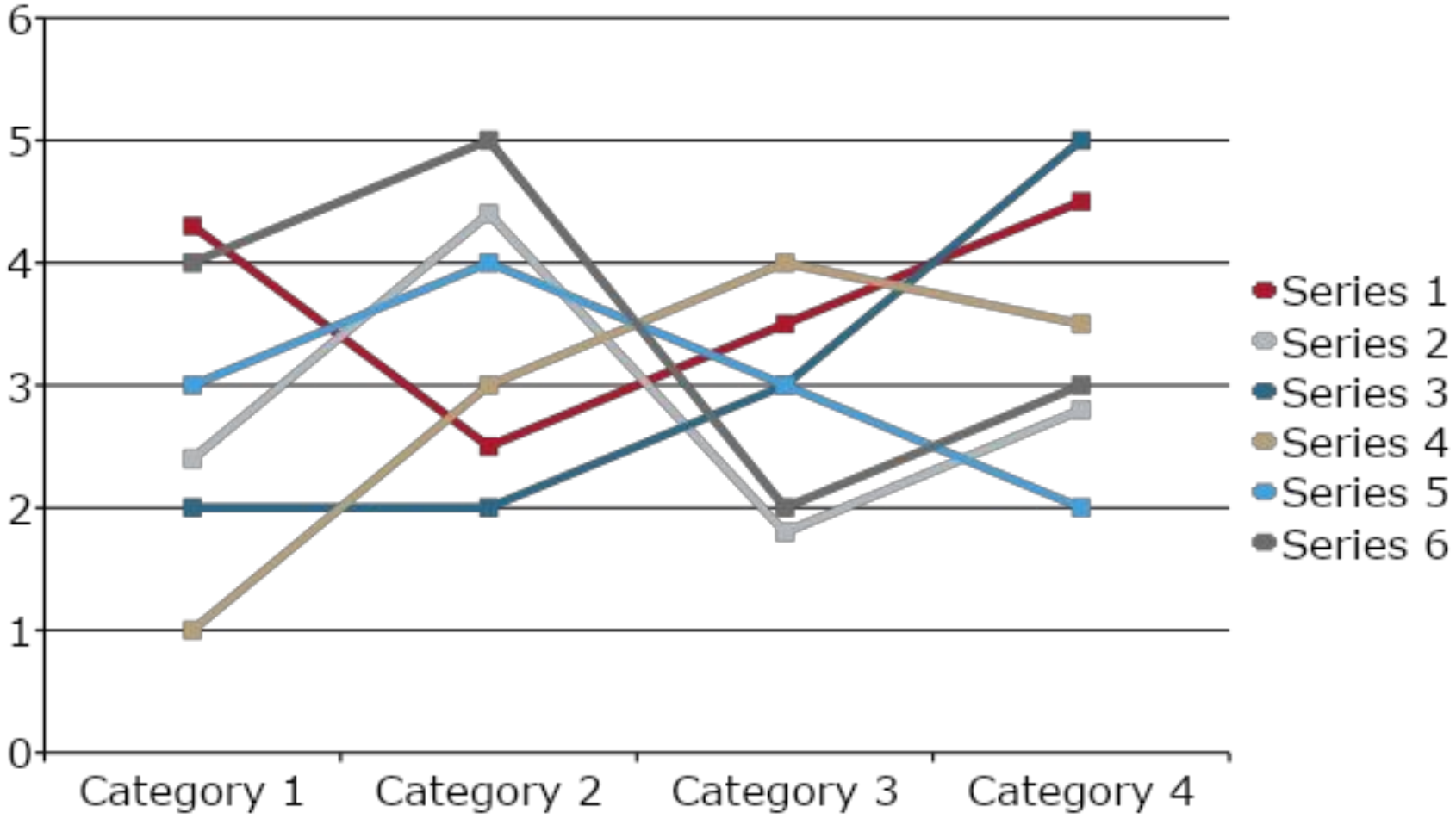
Layout: Content
Line Chart Sample



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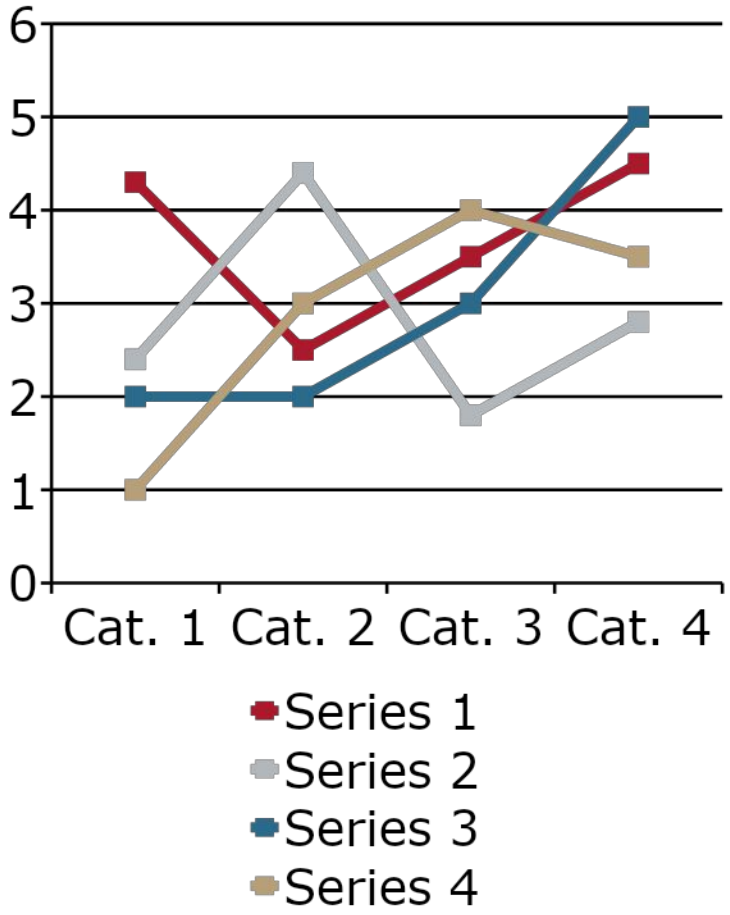
Line Chart Sample



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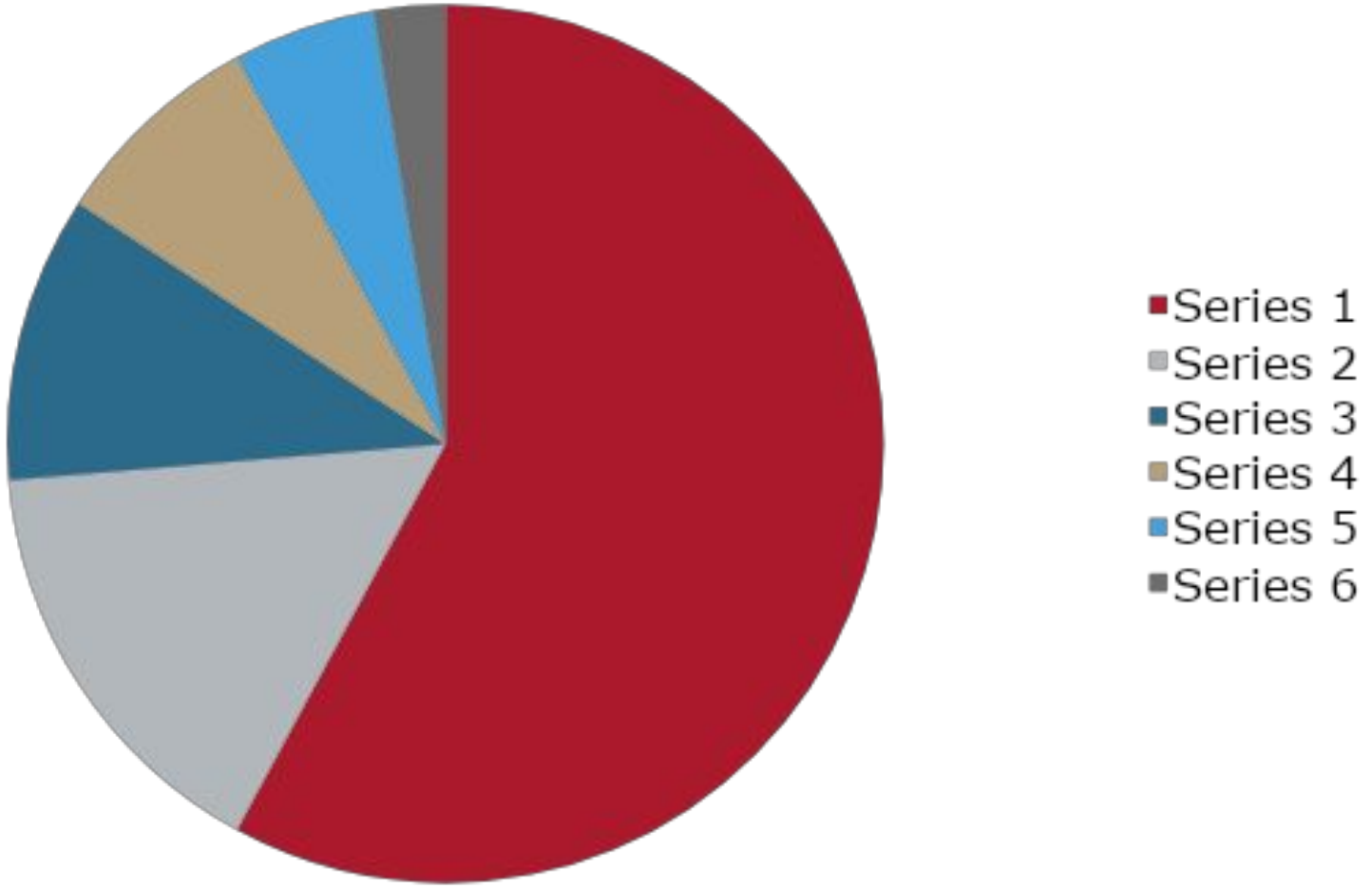
Layout: Content
Pie Chart Sample



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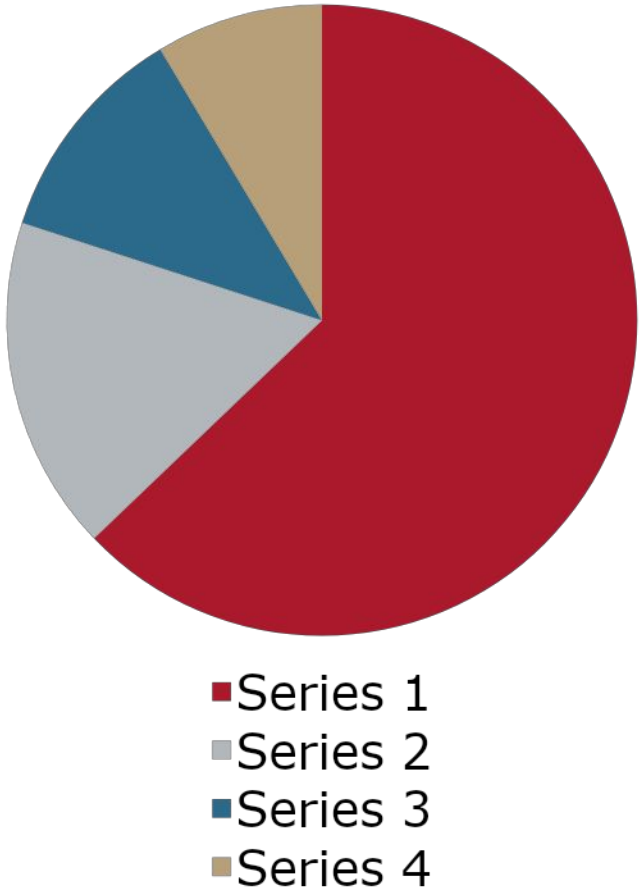
Pie Chart Sample



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