



Introducing **CAMIS**

Comparing Analysis Method Implementations in Software

Chi Zhang, PhD - on behalf of CAMIS WG

UseR! 2024 2024.7.10

About me



Disclaimer: opinions in this talk are all mine and do not reflect that of my employer

About me

Co-lead of CAMIS project since 2024.01



Carpentry@UiO



R-Ladies



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Today: **CAMIS**



Carpentry@UiO



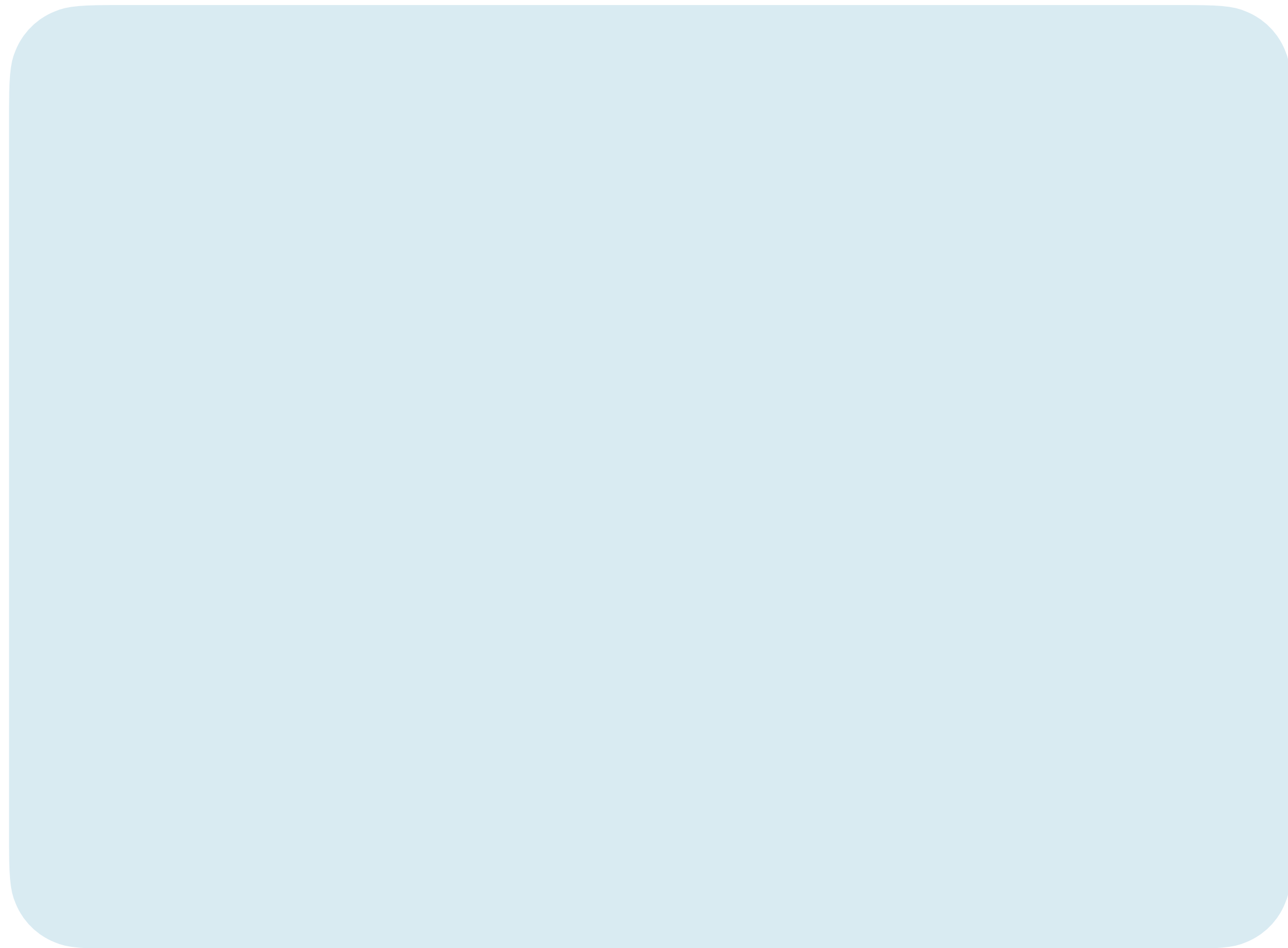
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Non-industry statistician / R dev



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PHARMA

The future of pharma is open source

Open source is changing how drug development happens. Clinical teams are making better decisions, working through clinical trials more confidently, are bringing life-changing drugs to market faster.

BOOK A CALL WITH OUR PHARMA EXPERTS

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Not sure about SAS, but I can help with the R
part - and they use **quarto!**

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Increase understanding and awareness of **analysis result discrepancies** across software (R, SAS, Python etc)

Demonstrate the methodology through **examples**, document in open GitHub repository

Repository location:
<https://psiaims.github.io/CAMIS/>



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Discrepancies

stata vs R, test for proportions

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. prtesti 1000 0.123 0.13
```

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One-sample test of proportion          x: Number of obs =    1000
```

	Mean	Std. err.	[95% conf. interval]	
x	.123	.0103861	.1026436	.1433564

```
p = proportion(x)                                z = -0.6582
```

$$H_0: p = 0.13$$

$H_a: p < 0.13$	$H_a: p \neq 0.13$	$H_a: p > 0.13$
$\Pr(Z < z) = 0.2552$	$\Pr(Z > z) = 0.5104$	$\Pr(Z > z) = 0.7448$

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(if not more!) - \$\$\$

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What if the p-values differ **around 0.05**?

Rounding

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`round(1.5) =`

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round(1.5) = > round(1.5)  
[1] 2
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round(0.5) = > round(0.5)  
[1] 0  
> janitor::round_half_up(0.5)  
[1] 1
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round(1.55, digits = 1) =  
> round(1.55, digits = 1)  
[1] 1.6
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In R, `round()` to the nearest even; in SAS, `round()` round half up

Pharmaverse blog has an article on this topic

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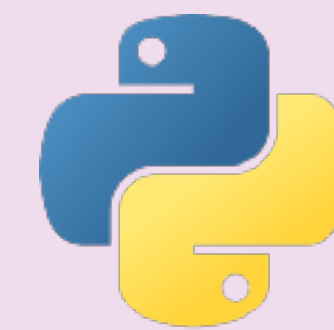
	round half up	round to even	round up	round down	round towards zero
Example:	1.5	1.4	2	1	1
1.45	(round to 1 decimal place)	(round to 1 decimal place)			

Here are the corresponding ways to implement these methods in SAS and R.

	round half up	round to even	round up	round down	round towards zero
SAS	<code>round()</code>	<code>rounde()</code>	<code>ceil()</code>	<code>floor()</code>	<code>int()</code>
R	<code>janitor::round_half_up()</code> <code>tidytlg::roundSAS()</code>	<code>base::round()</code>	<code>base::ceiling()</code>	<code>base::floor()</code>	<code>base::trunc()</code>

Zhang, Kangjie. 2023. "Rounding." August 22, 2023. https://pharmaverse.github.io/blog/posts/2023-07-24_rounding/rounding.html.

Why it matters



Why it matters

Shift **in industry** from SAS to R and open source software, e.g. pharmaverse



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In **public sector**: teaching, medical research and public health, SPSS / stata (even excel!) vs R, python



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Could be different **algorithms**; default **options**; floating point numbers; ... (*@adrianolszewski listed at least 14 different reasons*)



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Reproducibility challenges already exist even when there's *only one software* (set seed, package versioning, inaccessible sensitive data for revision, ...)



Trust in open source?



Open Source
Technology in Clinical
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11. Do we need to match SAS numerically when using a different language? #11


MichaelRimler started this conversation in General

**MichaelRimler** on Aug 24, 2023 (Maintainer)

- Is 100% match needed to establish trust - what is the 'truth'?
- How is this manifested for Conventional analyses (continuous and categorical summaries)?
- How is this manifested for Statistical inference and modeling?

...

Category


 General

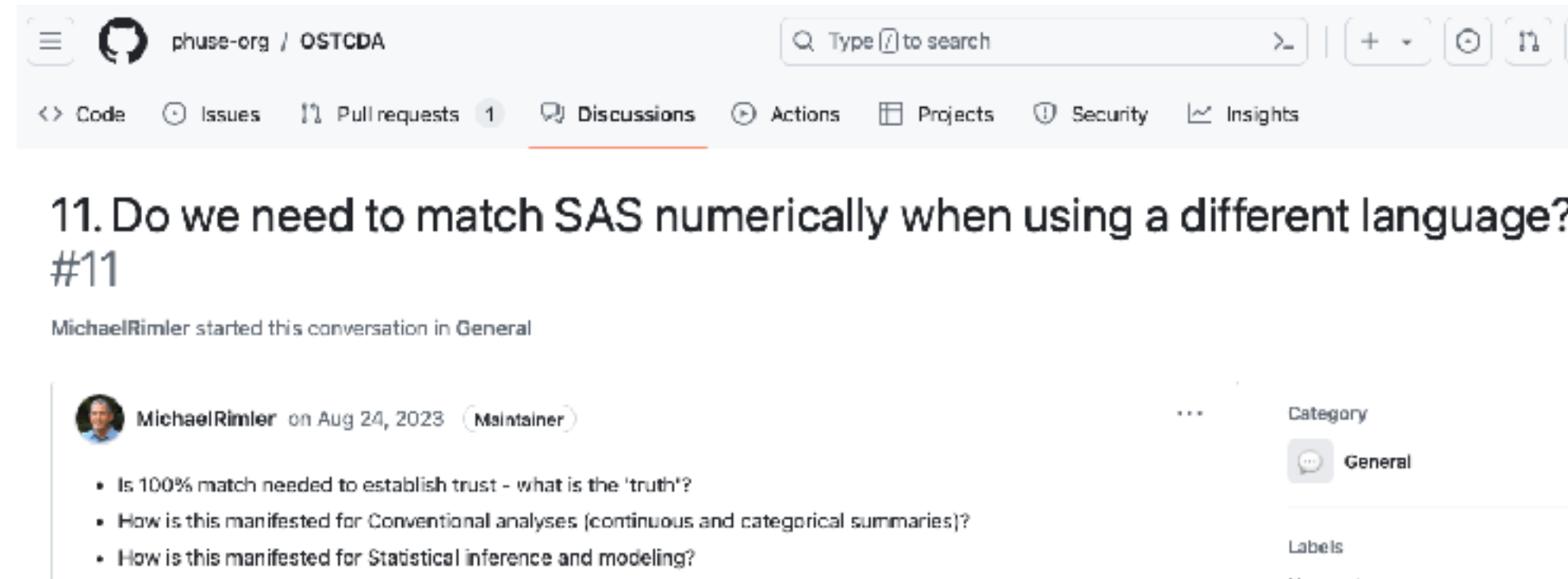
Labels

...

Trust in open source?





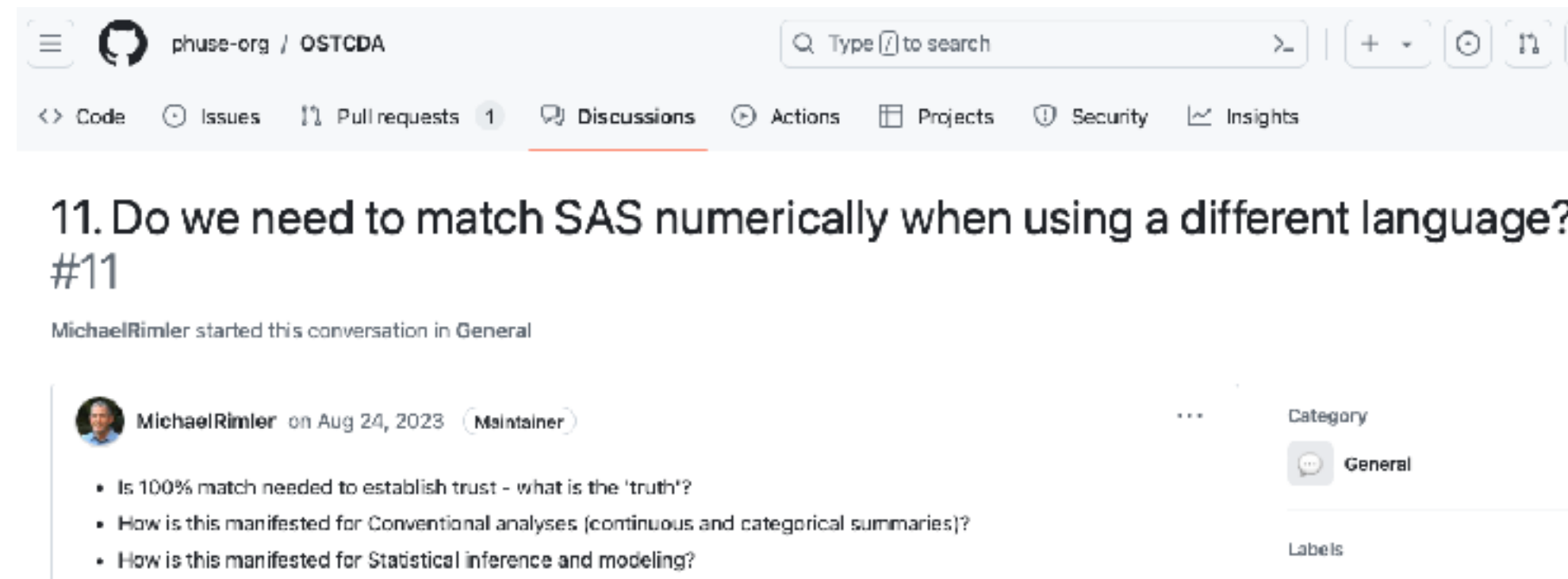
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Trust in open source?





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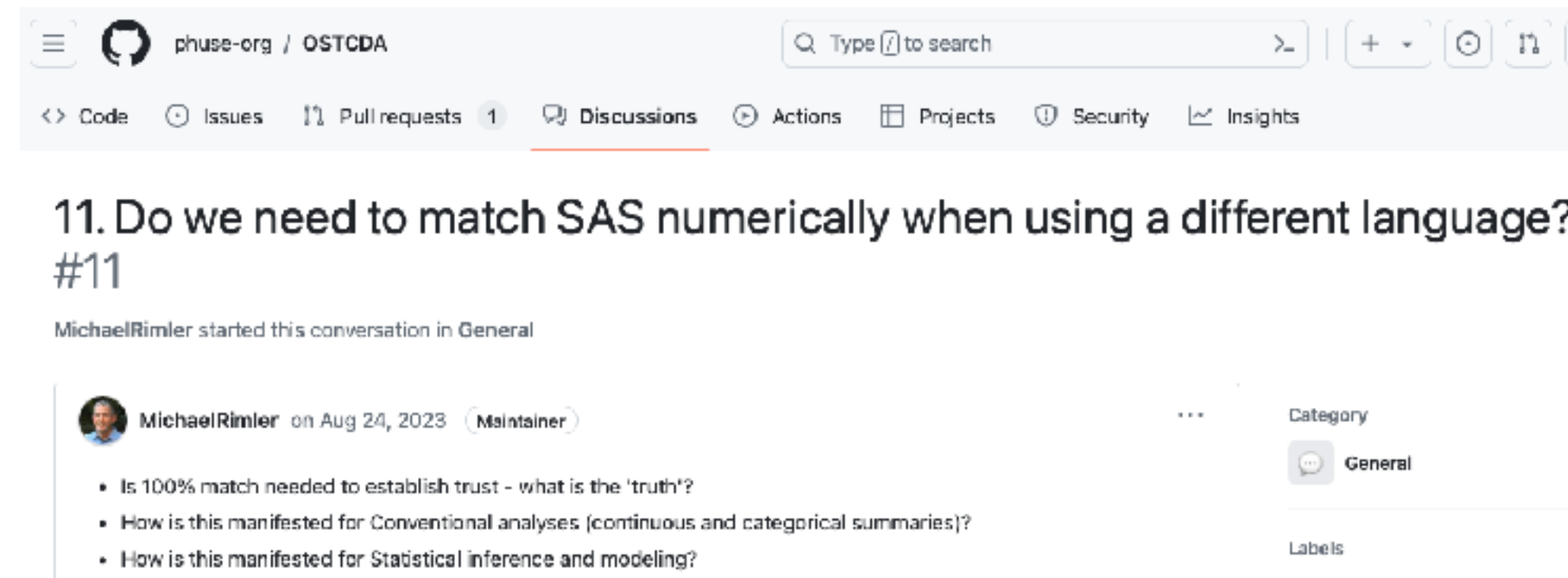


Accuracy, reproducibility, traceability (Modernization of Statistical Analytics Framework)

Trust in open source?



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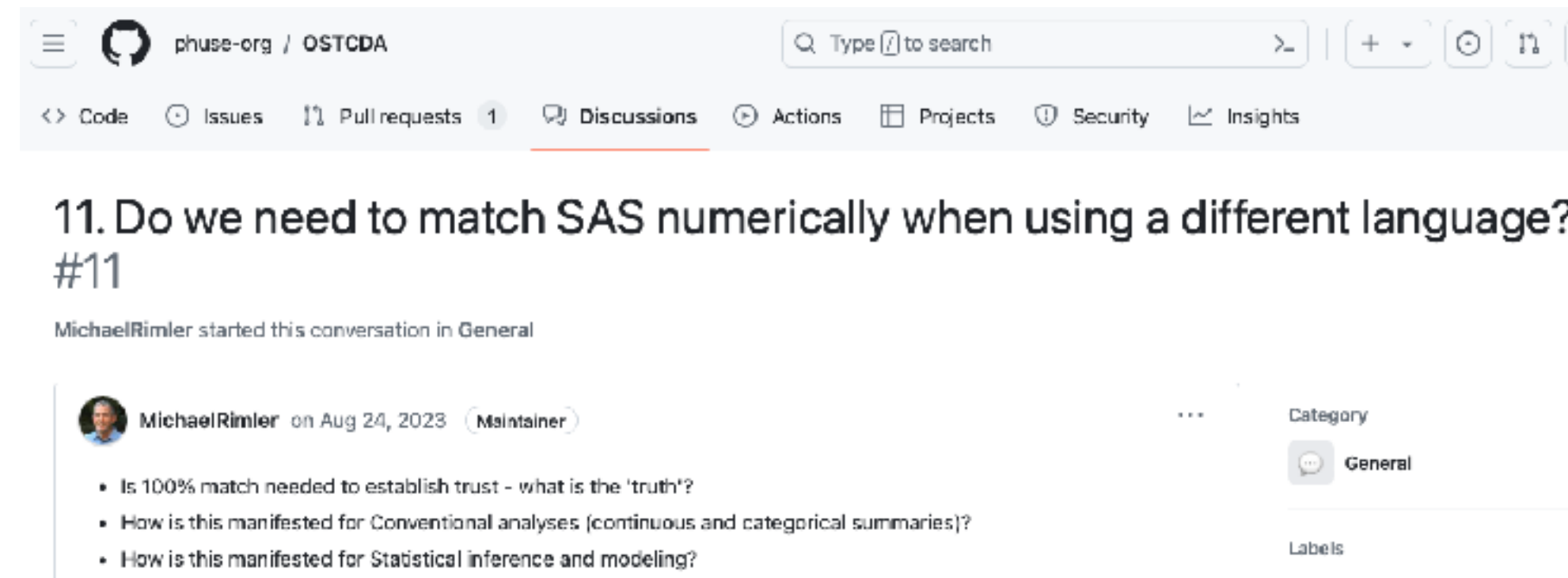
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
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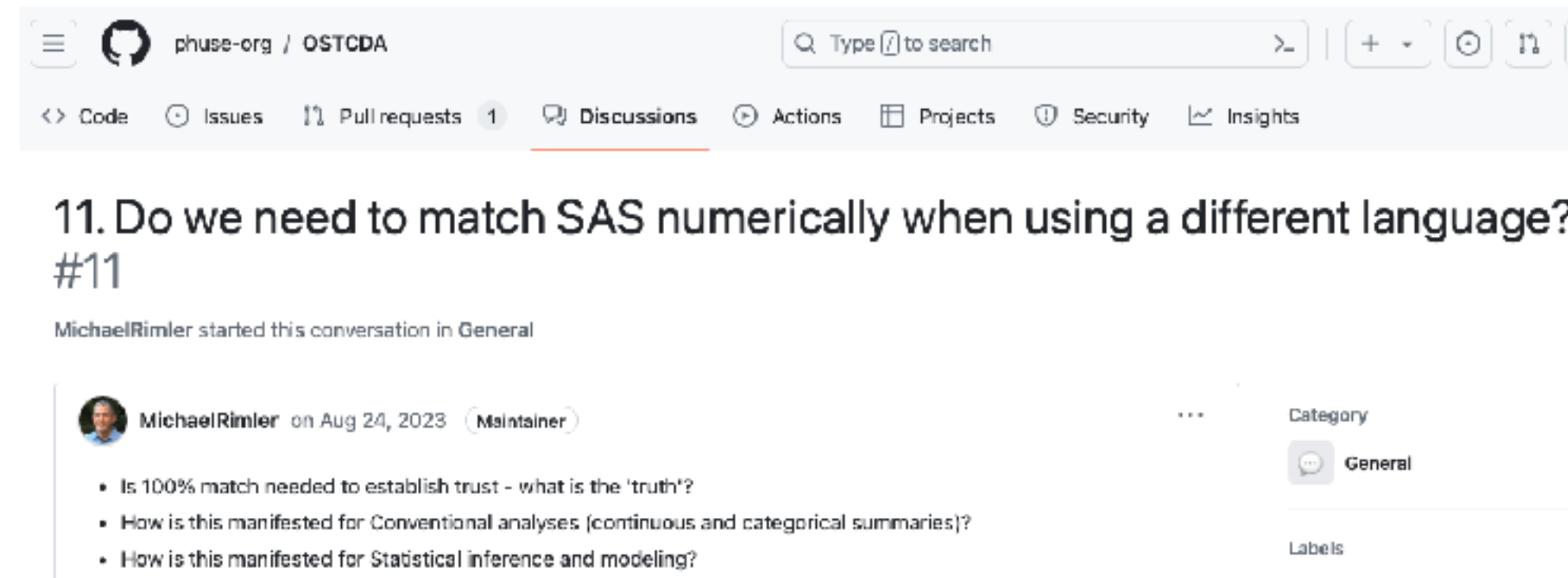
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It doesn't mean we need to match results 100%; but we should know **why** they are different

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It doesn't mean we need to match results 100%; but we should know **why** they are different



Rounding In CAMIS

```
round(1.5) = > round(1.5)  
[1] 2
```

```
round(0.5) = > round(0.5)  
[1] 0
```

```
round(1.55) = > round(1.55)  
[1] 2
```

```
round(1.55, digits = 1) =  
> round(1.55, digits = 1)  
[1] 1.6
```

Methods		R	SAS	Python	Comparison
Summary Statistics	Rounding	R	SAS	Python	R vs SAS
	Summary statistics	R	SAS	Python	R vs SAS
	Skewness/Kurtosis	R	SAS	Python	R vs SAS

R v SAS rounding

Rounding; R and SAS

On comparing the documentation of rounding rules for both languages, it will be noted that the default rounding rule (implemented in the respective language's round() function) are different. Numerical differences arise in the knife-edge case where the number being rounded is equidistant between the two possible results. The round() function in SAS will round the number 'away from zero', meaning that 12.5 rounds to the integer 13. The round() function in Base R will round the number 'to even', meaning that 12.5 rounds to the integer 12. SAS does provide the rounde() function which rounds to even and the janitor package in R contains a function round_half_up() that rounds away from zero. In this use case, SAS produces a correct result from its round() function, based on its documentation, as does R. Both are right based on what they say they do, but they produce different results (Rimler, M.S. et al.).

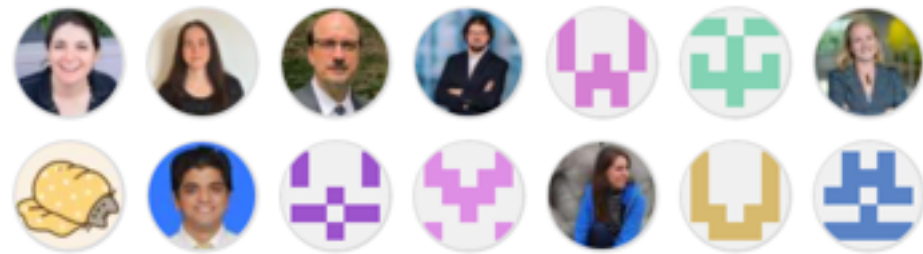
References

Rimler M.S., Rickert J., Jen M-H., Stackhouse M. Understanding differences in statistical methodology implementations across programming languages (2022, Fall). ASA Biopharmaceutical Report Issue 3, Volume 29. Retrieved from https://higherlogicdownload.s3.amazonaws.com/AMSTAT/fa4dd52c-8429-41d0-abdf-0011047bfa19/UploadedImages/BIOP%20Report/BioPharm_fall2022FINAL.pdf

Where are we now,
where do we go next?

CAMIS today

Contributors 18



[+ 4 contributors](#)

Deployments 187

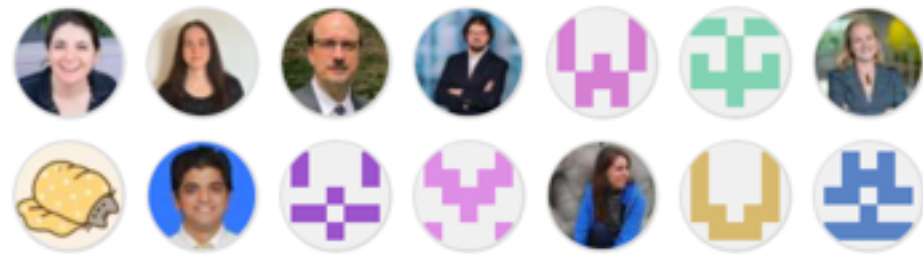
✓ github-pages 4 days ago

[+ 186 deployments](#)

Many participants on the monthly update meetings (*might not directly contribute to the content on GH, but in other ways - discussion, collaboration, presentation*)

CAMIS today

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[+ 4 contributors](#)

Deployments 187

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Documentation in **R, SAS, Python**

CAMIS today

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18






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Deployments


187

 **github-pages** 4 days ago

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About

Contribute

Publications and projects ▾

News ▾

Motivation

The goal of this project is to demystify conflicting results between software and to help ease the transitions to new languages by providing comparison and comprehensive explanations.

Repository

The repository below provides examples of statistical methodology in different software and languages, along with a comparison of the results obtained and description of any discrepancies.

On this page

Introduction

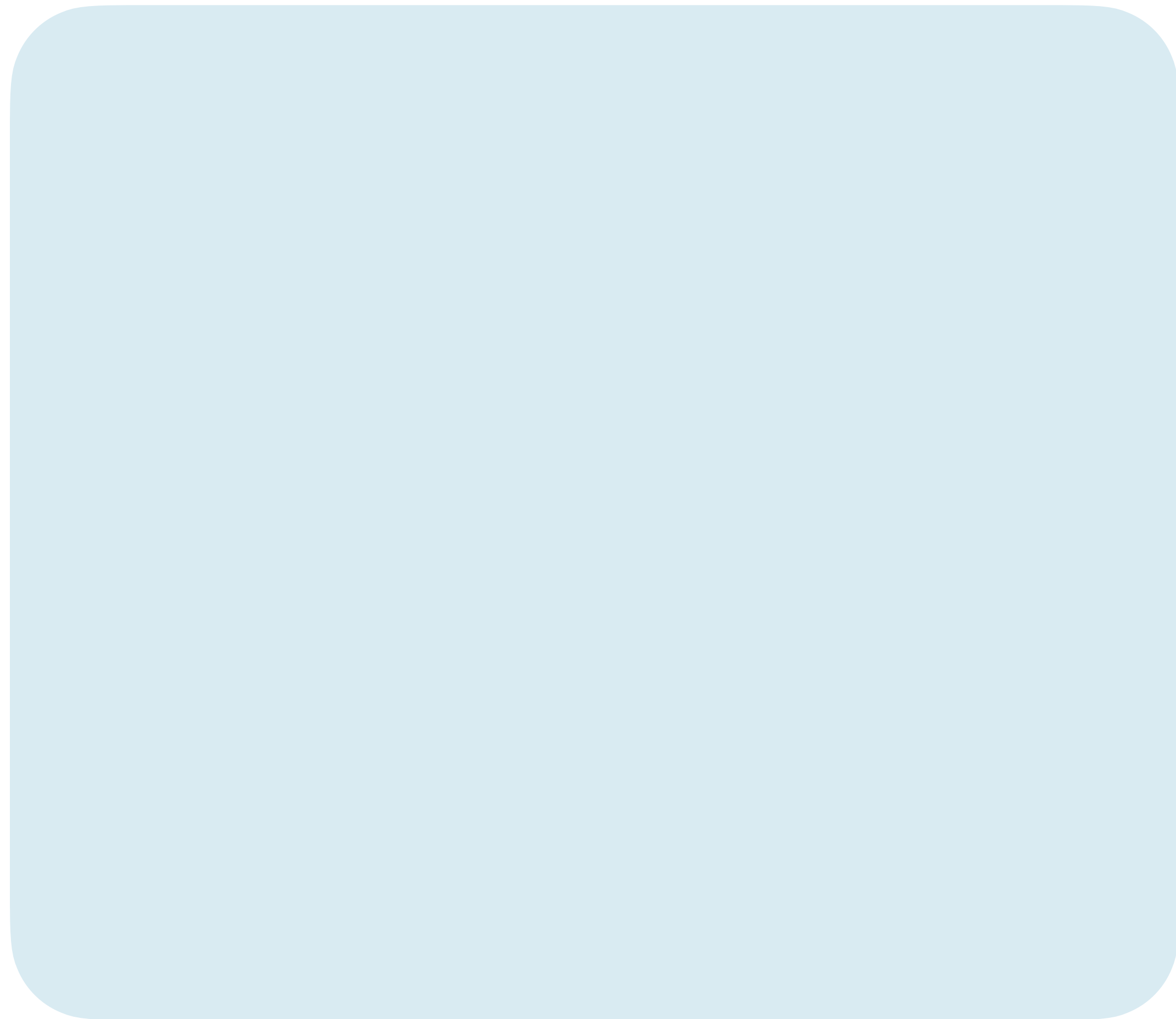
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Summary Statistics	Rounding	R	SAS	Python	R vs SAS
	Summary statistics	R	SAS	Python	R vs SAS
	Skewness/Kurtosis	R	SAS	Python	R vs SAS
General Linear Models	One Sample t-test	R	SAS	Python	R vs SAS
	Paired t-test	R	SAS	Python	R vs SAS
	Two Sample t-test	R	SAS	Python	R vs SAS
	ANOVA	R	SAS		R vs SAS
	ANCOVA	R	SAS	Python	R vs SAS
	MANOVA	R	SAS	Python	R vs SAS
	Linear Regression	R	SAS		R vs SAS
Generalized Linear Models	Logistic Regression	R	SAS		
	Poisson/Negative Binomial Regression	R			

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SAS vs R



CAMIS today

SAS vs R

Since CAMIS group has a focus on pharmaceutical industry, the **comparisons** are mostly in SAS vs R

CAMIS today

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Example page: one sample t-test

CAMIS today

SAS vs R

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One Sample t-test Comparison

The following table shows the types of One Sample t-test analysis, the capabilities of each language, and whether or not the results from each language match.

Analysis	Supported in R	Supported in SAS	Results Match	Notes
One sample t-test, normal data	Yes	Yes	Yes	In Base R, use <code>mu</code> parameter on <code>t.test()</code> function to set null hypothesis value
One sample t-test, lognormal data	Maybe	Yes	NA	May be supported by envstats package

Comparison Results

Normal Data

Here is a table of comparison values between `t.test()`, `proc_ttest()`, and SAS `PROC TTEST`:

Statistic	t.test()	proc_ttest()	PROC TTEST	Match	Notes
Degrees of Freedom	29	29	29	Yes	
t value	2.364306	2.364306	2.364306	Yes	
p value	0.0249741	0.0249741	0.0249741	Yes	

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Talk recording and slides she gave on *R/ Medicine 2024* is available on CAMIS website

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CAMIS today

About



psiaims.github.io/CAMIS/

Readme

Apache-2.0 license

Activity

Custom properties

43 stars

6 watching

21 forks

Report repository

Closed 37 issues

187 deployments of the website

Still many open issues - we need your help!

<input type="checkbox"/>	<div>46 Open ✓ 37 Closed</div>	Author ▾
<input type="checkbox"/>	<div><div>Pearson's/ Spearman's/ Kendall's Rank</div><div>Python</div><div>#216 opened 3 weeks ago by seemaniabhilipsa</div></div>	
<input type="checkbox"/>	<div><div>Website: dissertation info</div><div>documentation</div><div>#215 opened 3 weeks ago by andreaczhang 2 of 4 tasks</div></div>	
<input type="checkbox"/>	<div><div>MANOVA</div><div>Python</div><div>#208 opened on May 21 by seemaniabhilipsa</div></div>	
<input type="checkbox"/>	<div><div>Overall structure</div><div>#200 opened on May 6 by therneau</div></div>	
<input type="checkbox"/>	<div><div>Survey Statistics - Example/Comparison (Python)</div><div>Python</div><div>#185 opened on Apr 15 by michaelwalshe</div></div>	
<input type="checkbox"/>	<div><div>add more contribution guidance</div><div>#143 opened on Feb 7 by DrLynTaylor</div></div>	
<input type="checkbox"/>	<div><div>Add more information about the version of R running and package</div><div>#139 opened on Jan 25 by statasaurus</div></div>	
<input type="checkbox"/>	<div><div>Other Methods - Machine learning</div><div>Comparison R SAS</div><div>#67 opened on Mar 20, 2023 by statasaurus</div></div>	
<input type="checkbox"/>	<div><div>Other Methods - Causal inference</div><div>Comparison R SAS</div></div>	

We use Quarto



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Quarto has been the **publishing and collaboration** tool we use

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Easy to write articles, render results for multiple language (R, python)

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```
proc freq data = test_case;  
weight Count;  
tables treatment * Weight / chisq fisher;  
exact or;  
run;
```

Output:

The FREQ Procedure

Frequency Percent Row Pct Col Pct	Table of treatment by Weight		
	treatment	Weight	
		0	1
Trt_A	22	39	61
	10.33	18.31	28.64
	36.07	63.93	
	36.07	25.66	
Trt_B	39	113	152
	18.31	53.05	71.36
	25.66	74.34	
	63.93	74.34	
Total	61	152	213
	28.64	71.36	100.00

Statistics for Table of treatment by Weight

Statistic	DF	Value	Prob
Chi-Square	1	2.3072	0.1288
Likelihood Ratio Chi-Square	1	2.2490	0.1337
Continuity Adj. Chi-Square	1	1.8261	0.1766
Mantel-Haenszel Chi-Square	1	2.2964	0.1297
Phi Coefficient		0.1041	
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Output:

```
proc means data=htwt;  
run;
```

Descriptive Statistics for HTWT Data Set
The MEANS Procedure

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
AGE	AGE	237	16.4430380	1.8425767	13.9000000	25.0000000
HEIGHT	HEIGHT	237	61.3645570	3.9454019	50.5000000	72.0000000
WEIGHT	WEIGHT	237	101.3080169	19.4406980	50.5000000	171.5000000

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Output:

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proc means data=htwt;  
run;
```

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Variable	Label	N	Mean	Std Dev	Minimum	Maximum
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R packages and versioning: we're working on a solution with **renv**, getting help from posit!

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Active and welcoming community




AboutContributePublications and projects ▾News ▾

Blogs


Introduction Comparing Analysis Method Implementations in Software (CAMIS)

Are you trying to replicate results using different software/languages and struggling to find out why you can't match the results? Check out the CAMIS repository!




2023: A Year of Progress for the PHUSE CAMIS Working Group Project

As we draw towards the end of 2023, the PHUSE DVOST CAMIS Working Group Project reflect on their key progress and successes this year.



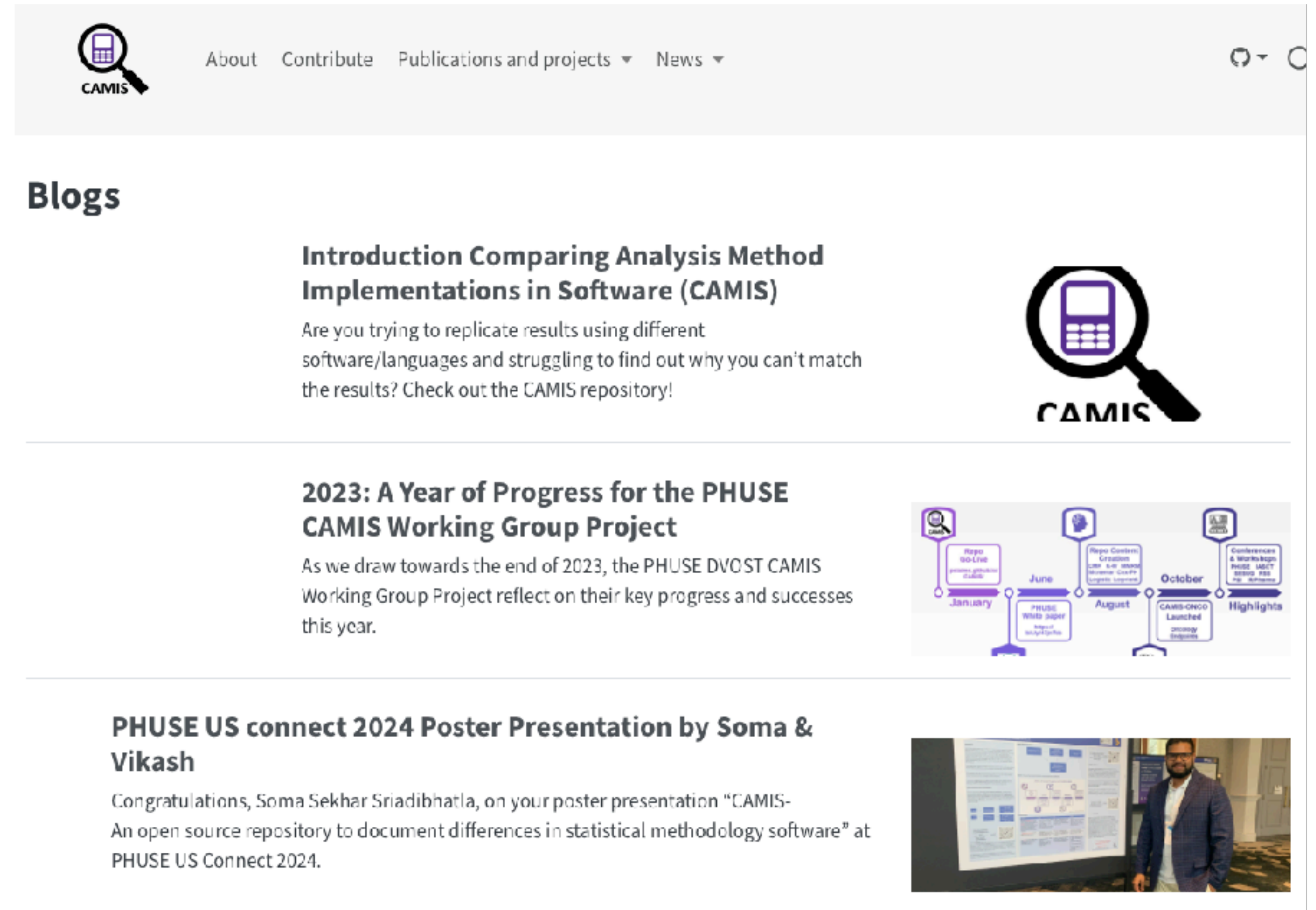
PHUSE US connect 2024 Poster Presentation by Soma & Vikash

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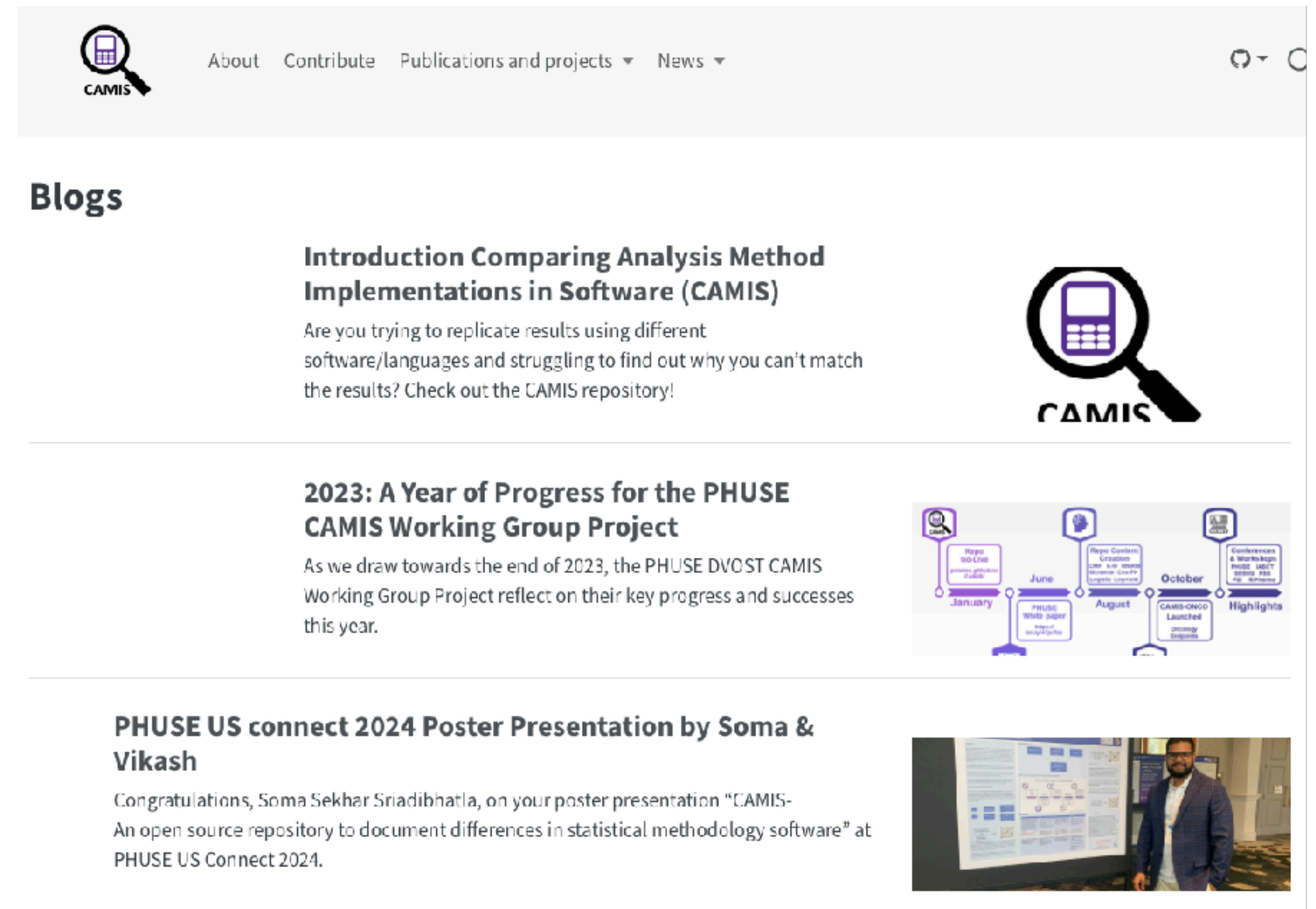
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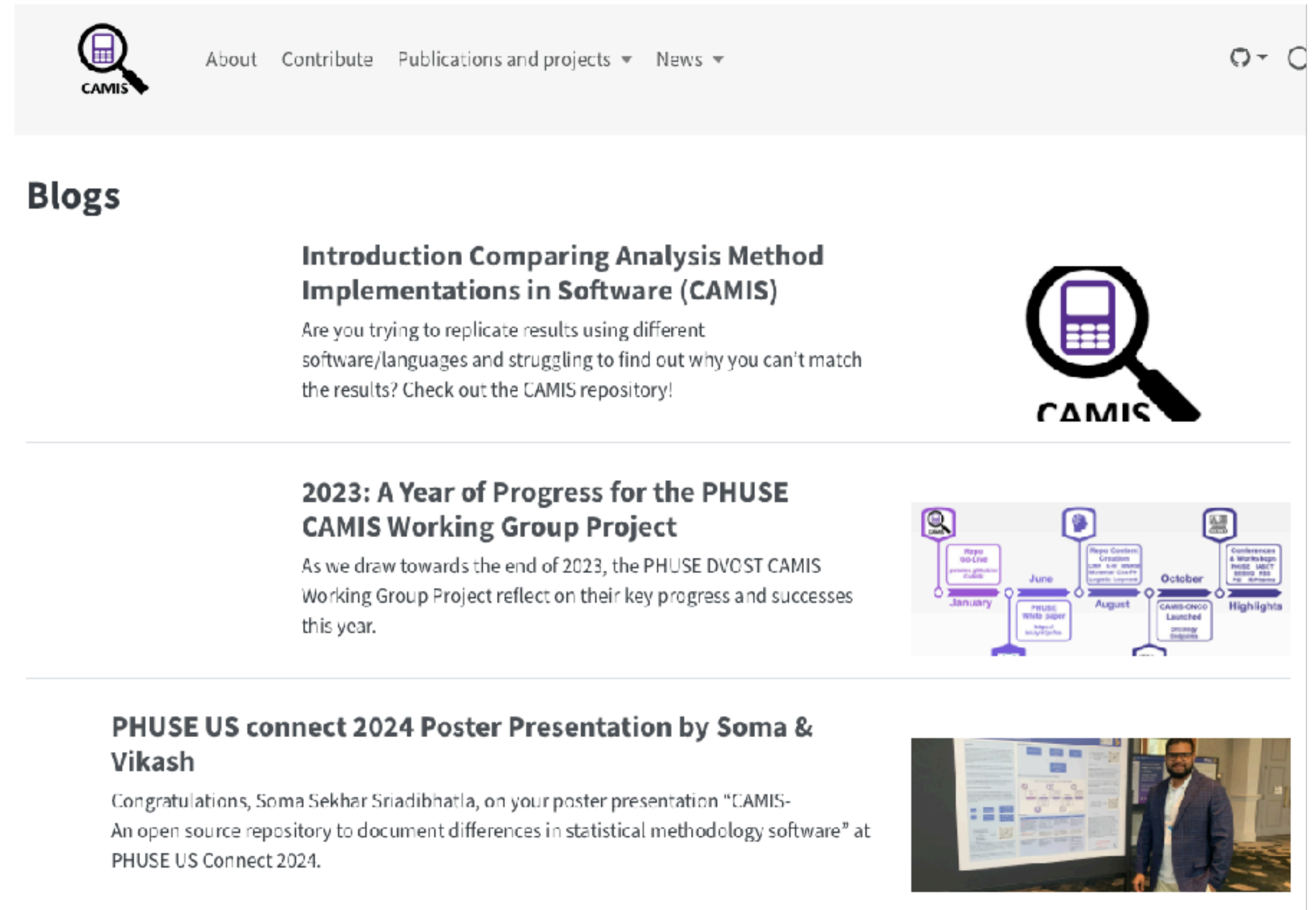
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Open and organized: meeting minutes openly accessible



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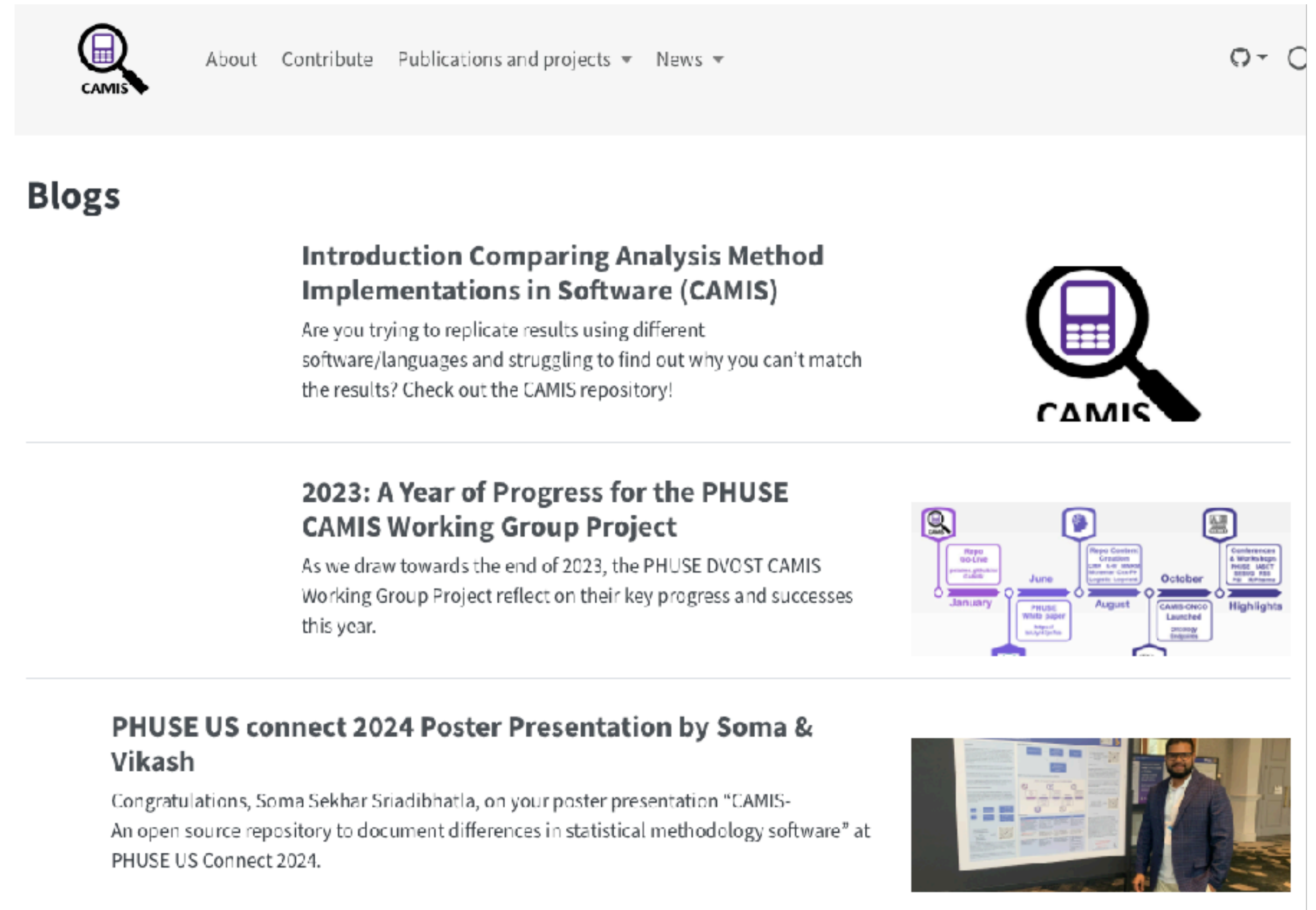
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Open and organized: meeting minutes openly accessible

Diverse and great vibes!



The screenshot displays the CAMIS website interface. At the top, a navigation bar includes a CAMIS logo (a magnifying glass over a calculator) and links for 'About', 'Contribute', 'Publications and projects', and 'News'. Below the navigation bar, the 'Blogs' section features a post titled 'Introduction Comparing Analysis Method Implementations in Software (CAMIS)' with a sub-header 'Are you trying to replicate results using different software/languages and struggling to find out why you can't match the results? Check out the CAMIS repository!'. To the right of this post is a large CAMIS logo. Below the blog post, a timeline titled '2023: A Year of Progress for the PHUSE CAMIS Working Group Project' shows key milestones from January to October, including 'Repo Go-Live', 'PHUSE White Paper', 'Repo Content Creation', 'CAMIS-ONCO Launched', and 'Conferences & Workshops'. To the right of the timeline is a small image of a person standing next to a poster. Below the timeline, a section titled 'PHUSE US connect 2024 Poster Presentation by Soma & Vikash' congratulates Soma Sekhar Sriadibhatla on his poster presentation 'CAMIS- An open source repository to document differences in statistical methodology software' at PHUSE US Connect 2024. To the right of this text is a small image of a person standing next to a poster.

Active and welcoming community

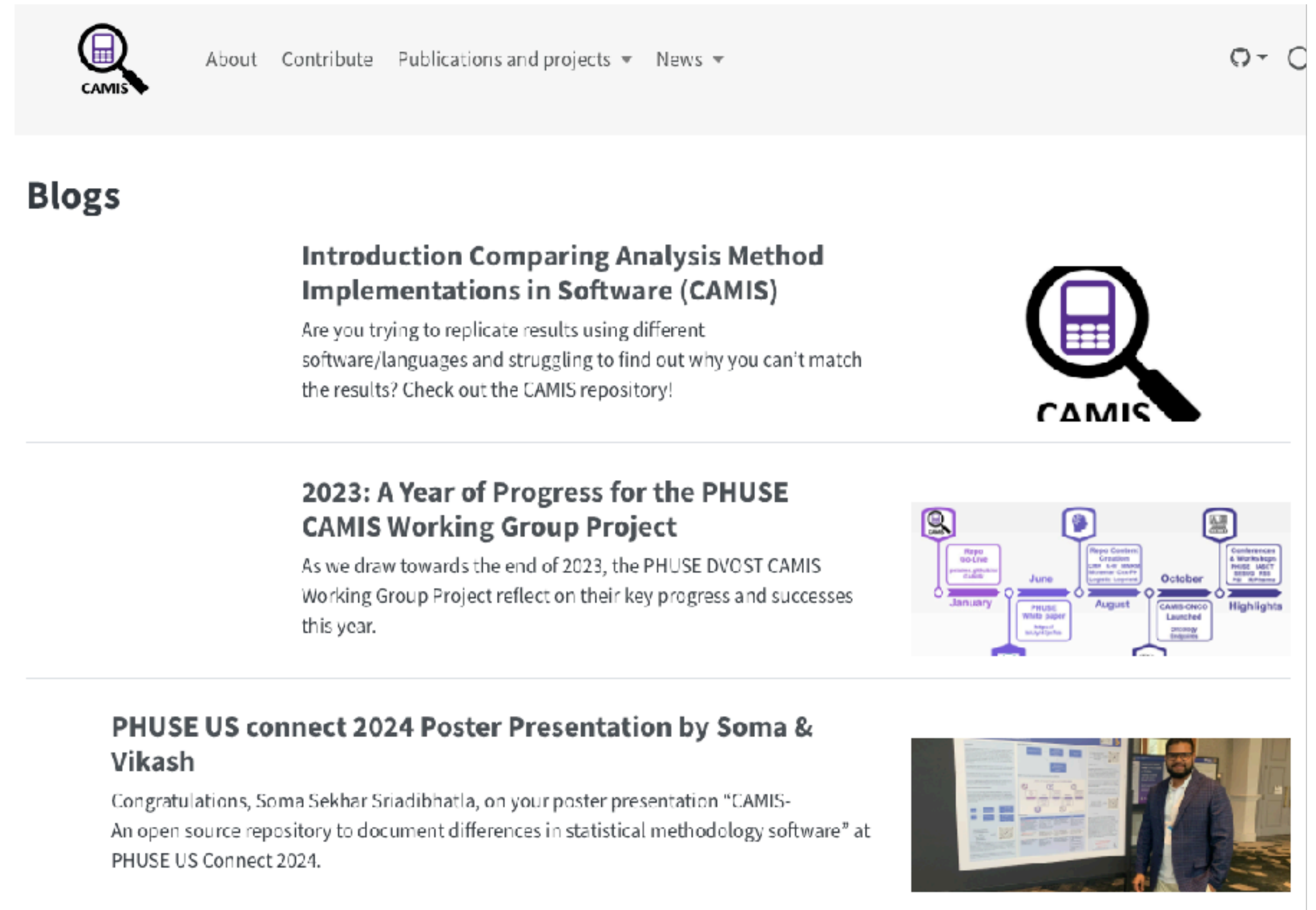
4 co-leads: **Lyn Taylor** (Parexel), **Christina Fillmore** (GSK), **Harshal Khanolkar** (Novo Nordisk), **Chi Zhang** (University of Oslo)

Community call once per month: discuss open issues, updates

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We encourage everyone to go out and present our group at conferences and seminars



The screenshot shows the CAMIS website with a navigation bar at the top containing links for 'About', 'Contribute', 'Publications and projects', and 'News'. Below the navigation bar is a 'Blogs' section. The first blog post is titled 'Introduction Comparing Analysis Method Implementations in Software (CAMIS)' and discusses replicating results using different software/languages. The second blog post is titled '2023: A Year of Progress for the PHUSE CAMIS Working Group Project' and provides a timeline of key events from January to October. The third blog post is titled 'PHUSE US connect 2024 Poster Presentation by Soma & Vikash' and congratulates Soma Sekhar Sriadibhatla on his poster presentation at PHUSE US Connect 2024. To the right of the blog posts is a large CAMIS logo. Below the timeline is a photo of Soma Sekhar Sriadibhatla standing next to his poster presentation.

Introduction Comparing Analysis Method Implementations in Software (CAMIS)
Are you trying to replicate results using different software/languages and struggling to find out why you can't match the results? Check out the CAMIS repository!

2023: A Year of Progress for the PHUSE CAMIS Working Group Project
As we draw towards the end of 2023, the PHUSE DVOST CAMIS Working Group Project reflect on their key progress and successes this year.

PHUSE US connect 2024 Poster Presentation by Soma & Vikash
Congratulations, Soma Sekhar Sriadibhatla, on your poster presentation "CAMIS- An open source repository to document differences in statistical methodology software" at PHUSE US Connect 2024.

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Conference name	Date (2024)	Location	Name Attending	Details	Website
RSS Local Group Seminar	28 Feb	Sheffield, England	Lyn Taylor	Slides	RSS
phuse US Connect	25-28 Feb	Bethesa, Maryland, USA	Soma Sekhar Sriadibhatla, Vikash Jain, Brian Varney	Poster	Connect
phuse chapter connect	03 APR	Bangalore	Harshal Khanolkar		
phuse/FDA CSS	3-5 June	Silver Spring Maryland, USA	Mike Stackhouse	CAMIS Discussion	CSS
R/Medicine	10-14 June	Online	Agnieszka Tomczyk, Lyn Taylor	Part1 and Part2 and slides	R/Medicine 2024
UseR!	8-11 July	Salzburg, Austria	Chi Zhang	Presentation	useR! 2024
phuse EU	11-13 Nov	Strasbourg, France	Agnieszka Tomczyk, Christina Fillmore	Presentation	PHUSE EU Connect

Ongoing discussions



Philip Bowsher • 1st

Director, Health and Life Sciences Industry Leader at Posit/RStudio PBC Ta...

3w • Edited •



Last week I attended a large pharma statistical programming conference (PharmaSUG) and a popular topic was CAMIS for understanding the source of differences between statistical software! Below is an overview:

CAMIS Website: <https://lnkd.in/gpRNGFCg>

In 2015, the FDA released the Statistical Software Clarifying Statement (<https://lnkd.in/gJug8S2u>) which states that the FDA does not require use of any specific software for statistical analyses.

Many organizations ([Roche](#), [Novo Nordisk](#), [GSK](#) etc.) are keen to use open source for Clinical Study Reports and to generate TFLs in the regulatory space.

One challenge has been observing differences across languages especially for complex TFLs.

Enter "Comparing Analysis Method Implementations in Software" CAMIS!!

The goal of CAMIS is to help understand the source of any differences between software and provide comparison and comprehensive explanations.

The team has collected and documented many SAS & R differences such as:

Repeated Measures Analysis:

<https://lnkd.in/ggfTFqjP>

Rounding:

<https://lnkd.in/gZtFZrps>



You and 438 others

23 comments • 38 reposts

Full discussion and post:



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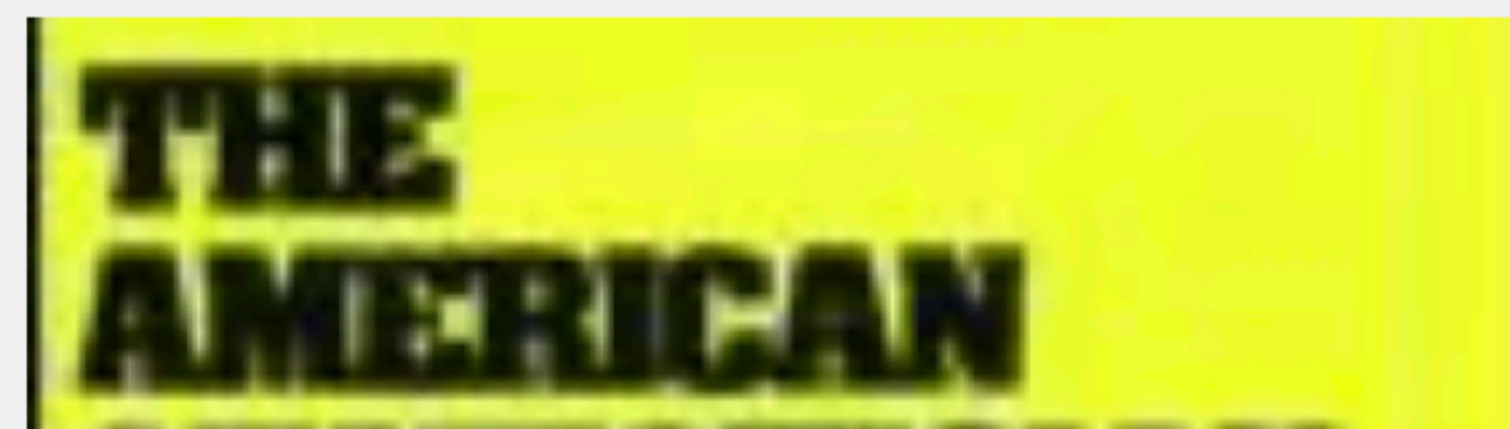


Stephen Senn • 2nd

Statistical Consultant

3w •

What a fascinating and important initiative. A classic paper is this by Reinhard Bergmann et al <https://www.tandfonline.com/doi/abs/10.1080/00031305.2000.10474513> . Another issue that surfaces is that different packages can use different approaches to parameterisation, especially in the presence of interactions. This can mean that they disagree in estimation even though they agree in prediction. The long standing debate on Type III v Type II SS is related to this. See discussion in <https://journals.sagepub.com/doi/10.1177/00928615000340022> 2 of an example of Christy Chiung-Stein's and Donald Tong.



Different Outcomes of the Wilcoxon—Mann—Whitney Test from Different St...

tandfonline.com

Like • 13 | Reply • 4 Replies

Full discussion and post:



Ongoing discussions

PHUSE Open Source Technology in Clinical Data Analysis WG

<https://github.com/phuse-org/OSTCDA/discussions/>

They have a community call to discuss relevant topics

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4 Documenting Trust

4.1 How do you document your trust in an open source solution?

- How do we have document our trust that an open source solution is accurate?
- How do we know if a third-party will accept our documentation of trust?

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Open Source
Technology in Clinical
Data Analysis  



Preface

- 1 What is Open Source?
- 2 Why Open Source?
- 3 Establishing Trust
- 4 Documenting Trust
- 5 Cost of Open Source
- 6 Regulatory Acceptance
- 7 GxP Compliance
- 8 User Support
- 9 User Development
- 10 [Numerical Matching](#)
- 11 OS in the Long Run
- 12 Funding OS

10 Numerical Matching

10.1 Do we need to match SAS numerically when using a different language?

- What if we the same inputs yield similar, but numerically different results?
- What if we the same inputs yield drastically different results?
- What is the truth? Which is correct?
- What if SAS and R are equivalent, but a third language yields numerical differences?

10.2 How to Contribute

Contribute to the discussion here in GitHub Discussions:

[Do we need to match SAS numerically when using a different language?](#)

10.3 Guidance

- Provide your thoughts and perspectives
- Provide references to articles, webinars, presentations (citations, links)
- Be respectful in this community

Collaboration

openstatsware - mmrm



R vs SAS MMRM

Introduction

In this vignette we briefly compare the `mmrm::mmrm`, SAS's `PROC GLIMMIX`, `nlme::gls`, `lme4::lmer`, and `glmmTMB::glmmTMB` functions for fitting mixed models for repeated measures (MMRMs). A primary difference in these implementations lies in the covariance structures that are supported “out of the box”. In particular, `PROC GLIMMIX` and `mmrm` are the only procedures which provide support for many of the most common MMRM covariance structures. Most covariance structures can be implemented in `gls`, though users are required to define them manually. `lmer` and `glmmTMB` are more limited. We find that `mmrm` converges more quickly than other R implementations while also producing estimates that are virtually identical to `PROC GLIMMIX`'s.

Convergence Times

FEV Data

The `mmrm`, `PROC GLIMMIX`, `gls`, `lmer`, and `glmmTMB` functions are applied to the FEV dataset 10 times. The convergence times are recorded for each replicate and are reported in the table below.

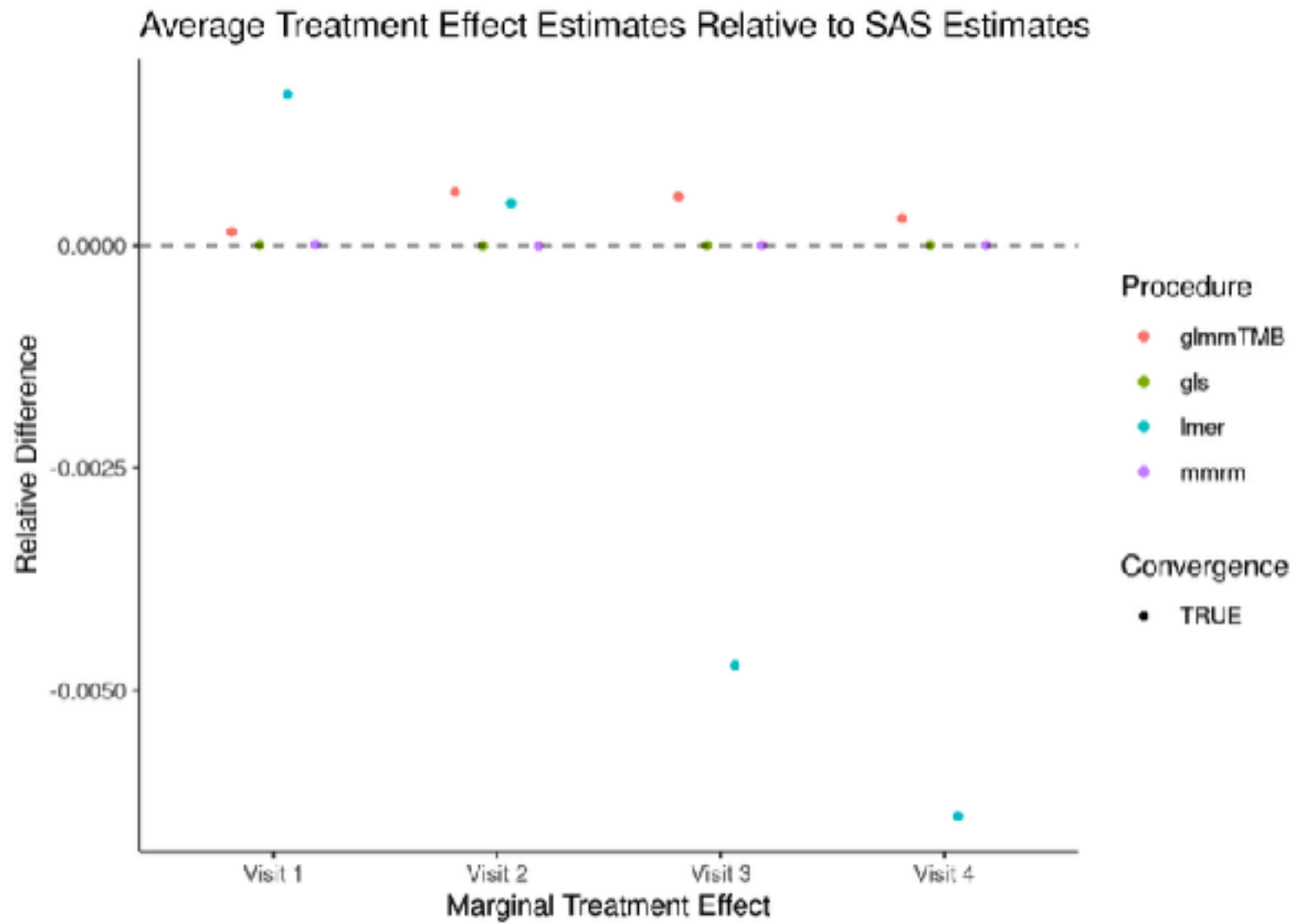
Comparison of convergence times: milliseconds			
Implementation	Median	First Quartile	Third Quartile
mmrm	56.15	55.76	56.30
PROC GLIMMIX	100.00	100.00	100.00
lmer	247.02	245.25	257.46
gls	687.63	683.50	692.45
glmmTMB	715.90	708.70	721.57

It is clear from these results that `mmrm` converges significantly faster than other R functions. Though not demonstrated here, this is generally true regardless of the sample size and covariance structure used. `mmrm` is faster than `PROC GLIMMIX`.

Marginal Treatment Effect Estimates Comparison

We next estimate the marginal mean treatment effects for each visit in the FEV and BCVA datasets using the MMRM fitting procedures. All R implementations' estimates are reported relative to `PROC GLIMMIX`'s estimates. Convergence status is also reported.

FEV Data



Possibility to add the Bayesian implementation as well

Collaboration

Academia - dissertation

NEW

Repeated Measures	Linear Mixed Model (MMRM)	R SAS R vs SAS
	Generalized Linear Mixed Model (MMRM)	
	Bayesian MMRM	
Multiple Imputation - Continuous Data MAR	MCMC	
	Linear regression	R
	Predictive Mean Matching	R
	Propensity Scores	
Multiple Imputation - Continuous Data MNAR	Delta Adjustment/Tipping Point	
	Reference-Based Imputation/Sequential Methods	
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Correlation	Pearson's/ Spearman's/ Kendall's Rank	R
Survival Models	Kaplan-Meier Log-rank test and Cox-PH	R SAS R vs SAS
	Accelerated Failure Time	
	Non-proportional hazards methods	
Sample size /Power calculations	Single timepoint analysis	
	Group-sequential designs	
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	Factor analysis	
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Collaboration

Academia - dissertation



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Contact us for more information!

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CAMIS has something for **everyone**



Read CAMIS Documents



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Topic of importance for
the biopharma industry
as well as research



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Like to be intellectually challenged and fascinated on something subtle



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Collaborate, network and make new friends



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Learn new topics on statistics and programming

How to get started

Contribution guidelines for new contributors

R template for topics to cover

Also we have information for contributors who are **new to GitHub** and Pull Request

Get started: check our **open issues** and comment to indicate your interest, or send us a message

We aim to close 45 issues this year - 37 so far

Help us achieve the goal :)

How to contribute to the documentation

Please contribute by **submitting a pull request** (PR) and our team will review it.

Adding a new page

If you are adding a new page, please follow our template guideline: [R template](#)

Good documentation on data, methods are very much appreciated!

First-time contributors

Welcome to CAMIS! Please read this article: [Get started](#), which contains some useful information to help you navigate your first PR submission.

Asking for help

If you need any assistance with setting up your workspace, do not hesitate to contact @DrLynTaylor, @stataaurus and @andreaczhang!

<input type="checkbox"/>	<input checked="" type="radio"/>	Sample size /Power calculations - Group-sequential designs	Comparison	R	SAS
#59 opened on Mar 20, 2023 by stataaurus					
<input type="checkbox"/>	<input checked="" type="radio"/>	Sample size /Power calculations - Single timepoint analysis	Comparison	R	SAS
#58 opened on Mar 20, 2023 by stataaurus					
<input type="checkbox"/>	<input checked="" type="radio"/>	Survival Models - Non-proportional hazards methods	Comparison	R	SAS
#57 opened on Mar 20, 2023 by stataaurus					
<input type="checkbox"/>	<input checked="" type="radio"/>	Survival Models - Accelerated Failure Time	Comparison	R	SAS
#56 opened on Mar 20, 2023 by stataaurus					

Resources



CAMIS website: <https://psiaims.github.io/CAMIS/>

GitHub Repo: <https://github.com/PSIAIMS/CAMIS/>

Open issues: [https://github.com/PSIAIMS/CAMIS/
issues](https://github.com/PSIAIMS/CAMIS/issues)

PHUSE discussions

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<https://github.com/phuse-org/OSTCDA/discussions/11>

How to document your trust in an open source solution?
https://phuse-org.github.io/OSTCDA/doc_trust.html

Please feel free to reach out to the co-leads, you can find us on LinkedIn

Lyn Taylor
Christina Fillmore
Harshal Khanolkar
Chi Zhang

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