# PSYCHOSTATISTICS

Newsletter of the Quantitative Methods Section of CPA

# Message from the Chair

Let me begin this year's remarks with a confession: I limped across the finish line of this academic year. Barely.

I expect that my experience will resonate with many of my colleagues so rather than extol the scholarly achievements of our Section I am taking this opportunity to say that we should all be proud and deeply grateful to have survived this past year and, as much as possible, showed up to support our students and trainees.

Perhaps most visibly, this occurred for many of us in the form of online teaching. Though I personally had experience with online courses before this year, I'd wager that most instructors teaching statistics online were doing so for the first time. Teaching statistics to psychology students is a tricky task under ideal conditions—at the undergraduate level, students can be ambivalent about their mandatory statistics training or worse, openly hostile.

At the graduate level, students are keen but highly anxious about their math competency.

I usually rely heavily on eye contact with students and nonverbal cues to assess whether students are grasping difficult concepts. I found that the distance imposed between me and my students by the virtual environment really impaired my ability to follow students' in-class understanding and to build relationships with students. At the same time, students overwhelmingly appreciated video recordings of each lecture and video demonstrations in software. Many of them also felt the loss of the face-to-face classroom experience but liked the flexibility of an online class in a climate of uncertainty.

As many of us look forward to a return to normalcy, I encourage us all to import the strongest tools we accumulated over the past months to future classes, be they in person or online. For me, this will mean enhancing out-of-classroom materials, including recorded videos for key activities like software demonstrations. This will also mean continuing to be flexible and compassionate both in structuring student

assessments as well as setting deadlines.

I hope you will join us at the 2021 CPA virtual convention. Quantitative Methods section programming will occur the week of June 14th, and features virtual poster sessions, symposia, 5-minute "snapshot" presentations, and a preconvention workshop on Bayesian statistics. We are also delighted to welcome Dr. Bruno Zumbo, Tier I Canada Research Chair in Psychometrics and Measurement, who will deliver an invited address titled *Equity and Fairness at the Nexus of Data Science, Psychometrics, Digital Innovation, and Social Justice*.

See you in June,

*Andrea Howard*
*Chair, Quantitative Methods Section*

# Message from the Student Rep

Hello members and friends of the Quantitative Methods (QM) section, and welcome *Psychostatistics* enthusiasts!

My name is Udi Alter and it is my absolute pleasure to serve as the student representative for the QM section. This year marks the QM section's 9th birthday, and what a year it has been. Although this is not our first online convention, this past year has presented many challenges and changes that touched all of us.

Now, perhaps more than ever, it is so important to maintain a sense of community and connection with fellow students and researchers. For me, moving my entire schooling online has had its fair share of drawbacks, but also some benefits. For example, I was able to meet, network, and collaborate with researchers from across the country and around the globe. I also had the privilege of joining "far away" meetings, clubs, and workshops which were previously held in

person (or came with a hefty fee).

In my opinion, one of the best things about the Canadian QM community is its small (sample) size (unlike in statistics). Having a small section makes it easier for individuals to know one another and maintain a sociable environment and collegial support. That said, another beautiful thing about our area is that quantitative skills are used in all psychology subdisciplines. Consequently, our QM community includes researchers from a diverse range of backgrounds and interests who are passionate about statistics. So, you don't need to be an expert methodologist; if you're interested in QM (or even skeptical, but curious), we welcome you with open arms! And, what better opportunity to get to know the QM community than the CPA convention?

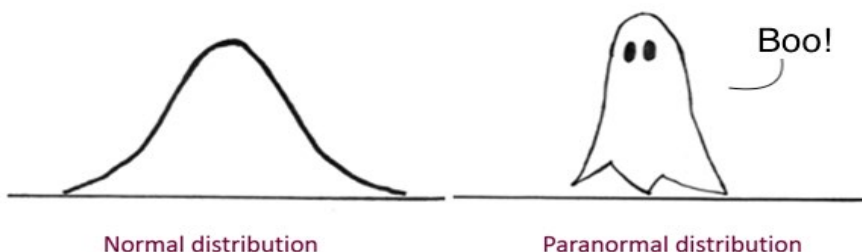This year, too, we are expecting sensational sessions: workshops, posters,

and symposia. We welcome and encourage you to attend as many sessions as you can. In addition, if you are interested to learn more about our section, QM training in Canada, how to get involved, and meeting awesome people, please also join our annual QM section business meeting and QM social. Finally, if you have specific questions about the section, being a quantitative psychology student, QM-related resources etc., my (virtual) door is always open! And, of course, feedback and suggestions from students about the QM area are always appreciated.

I'm very much looking forward to reconnecting with QM friends and colleagues at the upcoming online convention, and I'm psyched (pun intended) to meet all the new QM members!

See you in June,

*Udi Alter*
*udi.alter@ryerson.ca*
*Student Representative,*
*Quantitative Methods Section*

## *QUANTITATIVE METHODS SECTION OF CPA*

Website:
https://canadianquantpsych.ca/

Listserv:
qmcpa@yorku.ca

Twitter:
@qm_cpa

# QM Laugh



Normal distribution

Paranormal distribution

Boo!

## Did You Know?

CPA is very interested in increasing the number of QM workshops at the convention. Have an idea for a workshop? Tweet us at @qm_cpa.

# Visual Insights

*If you see a neat visualization, tweet it to @qm_cpa*

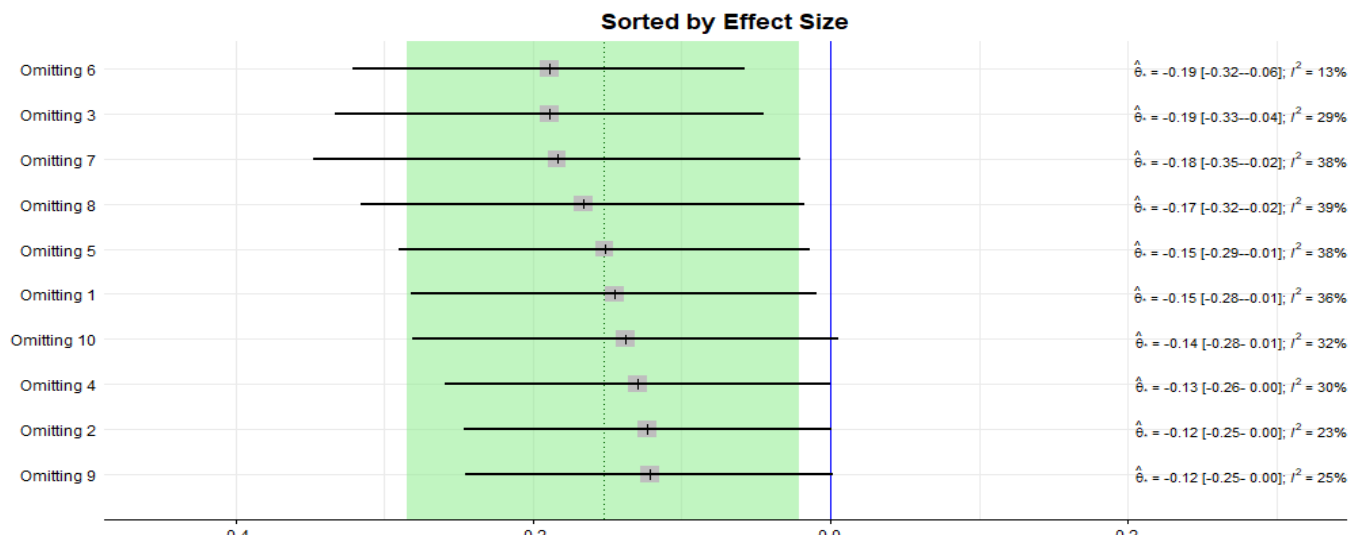## Leave-one-out Plot for Meta-Analysis

An important part of conducting a meta-analysis is identifying outliers; in other words, extreme effect size ($\Theta$) values that could be impacting the meta-analytic (i.e., combined) effect size value. Packages such as `metaphor` make it easy to run analyses to identify influential observations. For example, using leave-one-out analyses, it is possible for researchers to see the impact removing a specific study on the meta-analytic effect size, heterogeneity, etc. However, the plotting capabilities to accompany these analyses are often limited. R packages `meta` and `dmetar` to the rescue.

Let's look at a fictious example where we have 10 studies, each looking at the difference between males and females in maladaptive perfectionism. The data look like this, with means (M), standard deviations (SD), and sample sizes (N) for males and females:

```
   Study  M_male  SD_male  N_male  M_female  SD_female  N_female
1      1    2.89     0.79      28      3.12       0.65        26
2      2    2.69     0.55      26      3.00       0.54        28
3      3    2.90     0.58      98      2.86       0.61        99
4      4    2.62     0.54      42      2.85       0.57        33
5      5    2.96     0.36      24      3.07       0.55        21
6      6    2.93     0.60     184      2.89       0.60       184
7      7    2.86     0.59     274      2.91       0.52       255
8      8    2.50     0.84      58      2.60       0.83        55
9      9    2.41     0.78      34      2.74       0.51        34
10    10    2.54     0.66      99      2.72       0.68        95
```

The following code will produce a forest plot sorted by $\Theta$ (standardized mean difference), but indicating in each case which study (1-10) has been left out. The confidence interval for $\Theta$ and the $I^2$ measure of heterogeneity are also displayed.

```
library(dmetar); library(meta); library(metafor)
metaperf <-  metacont(data=dat, n.e = N_male, n.c = N_female, sd.e = SD_male,
    sd.c = SD_female, mean.e = M_male, mean.c = M_female, method.tau = "REML", sm
    = "SMD", studlab = Study)
inf.analysis <- InfluenceAnalysis(x = metaperf, random = TRUE)
plot(inf.analysis, "es")
```

### Sorted by Effect Size

| Omitting | | |
|---|---|---|
| Omitting 6 | | $\hat{\theta}_{-i} = -0.19\ [-0.32\text{--}0.06];\ I^2 = 13\%$ |
| Omitting 3 | | $\hat{\theta}_{-i} = -0.19\ [-0.33\text{--}0.04];\ I^2 = 29\%$ |
| Omitting 7 | | $\hat{\theta}_{-i} = -0.18\ [-0.35\text{--}0.02];\ I^2 = 38\%$ |
| Omitting 8 | | $\hat{\theta}_{-i} = -0.17\ [-0.32\text{--}0.02];\ I^2 = 39\%$ |
| Omitting 5 | | $\hat{\theta}_{-i} = -0.15\ [-0.29\text{--}0.01];\ I^2 = 38\%$ |
| Omitting 1 | | $\hat{\theta}_{-i} = -0.15\ [-0.28\text{--}0.01];\ I^2 = 36\%$ |
| Omitting 10 | | $\hat{\theta}_{-i} = -0.14\ [-0.28\text{-}\ 0.01];\ I^2 = 32\%$ |
| Omitting 4 | | $\hat{\theta}_{-i} = -0.13\ [-0.26\text{-}\ 0.00];\ I^2 = 30\%$ |
| Omitting 2 | | $\hat{\theta}_{-i} = -0.12\ [-0.25\text{-}\ 0.00];\ I^2 = 23\%$ |
| Omitting 9 | | $\hat{\theta}_{-i} = -0.12\ [-0.25\text{-}\ 0.00];\ I^2 = 25\%$ |

# Consulting Corner

**Question**

*While working on a structural equation model (SEM), the software tagged the model-implied correlation matrix as "non-positive definite". I identified this as a type of Heywood case, but upon exploring said matrix I could not find correlations greater than one or negative elements in the diagonal. Without these indicators, I do not know how to find which variable(s) are creating the problem. Why is this matrix non-positive definite? And, is it possible to identify which variables are at fault?*

**Answer**

A Heywood case usually refers to either a negative variance or a correlation greater than one. None of those two conditions are present in the above matrix, but an eigen decomposition of said matrix yields a negative eigenvalue of about -0.131. So there is something wrong with this "correlation" matrix. To identify which variables in this case may be at fault, we can use a property of positive definite matrices known as the Sylvester criterion. A matrix is positive definite if and only if all its **leading minors** are also positive definite. And covariance/correlation matrices are, by construction, positive definite. Therefore, one can simply apply the Sylvester criterion to the above matrix to diagnose where the problem is. A visual is perhaps the easiest way to convey what a "leading minor" is, with each colour being "leading minor".

A useful strategy to use the Sylvester criterion is by indexing each leading minor of the correlation matrix in R (or any other software) and taking their determinant to see how it shrinks towards zero to identify which variable is creating the Heywood case. Assume S is the correlation matrix above. Notice that the leading minor is the constant 1, which is positive, so the first leading minor is positive definite. Then one can do:

```
> det(S[1:2,1:2])
[1] 0.641199
> det(S[1:3,1:3])
[1] 0.2933427
> det(S[1:4,1:4])
[1] 0.01973229
> det(S[1:5,1:5])
[1] 0.003930676
> det(S[1:6,1:6])
[1] -0.003353769
```

| 1 | .599 | .706 | .702 | .591 | .627 | .493 |
|------|------|------|------|------|------|------|
| .599 | 1 | .646 | .459 | .582 | .964 | .620 |
| .706 | .646 | 1 | .653 | .844 | .510 | .981 |
| .702 | .459 | .653 | 1 | .776 | .325 | .687 |
| .591 | .582 | .844 | .776 | 1 | .639 | .944 |
| .627 | .964 | .510 | .325 | .639 | 1 | .642 |
| .493 | .620 | .981 | .687 | .944 | .642 | 1 |

The 6th variable (leading minor in yellow) is where the problem lies. Further inspection showed that this was a negatively-worded item which had not been reverse-keyed before analysis.

**Thanks to Dr. Oscar Olvera Astivia, University of Washington, for this issue's *Consulting Corner*.**

# QM Section's 'Student Presentation Award'

Back in 2016, the QM Section initiated the *Student Presentation Award*, given annually at each CPA convention.

Winners of the *Student Presentation Award* receive a special invitation to publish their work in the [Quantitative Methods for Psychology journal (TQMP)](.).

The 2020 winner of the *Student Presentation Award* was Raymod Luong, a PhD student in the Quantitative Psychology and Modeling program at McGill University. Raymond's presentation was titled "Testing measurement invariance: The traditional nested model approach versus the alignment method."

We look forward to all the great student presentations at virtual CPA 2021!
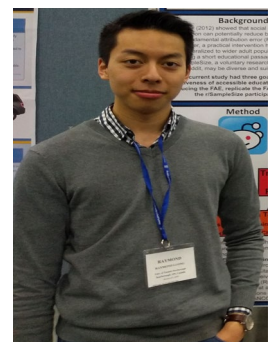
# QM Invited Speaker at CPA 2021: Dr. Bruno Zumbo!

The Quantitative Methods Section of the Canadian Psychological Association is delighted to welcome **Dr. Bruno Zumbo**, Tier I Canada Research Chair in Psychometrics and Measurement, to deliver this year's Featured Speaker address at the 2021 CPA Convention on Thursday, June 17th at 2:30 PM (Eastern Standard Time).

Dr. Zumbo's talk is titled *Equity and Fairness at the Nexus of Data Science, Psychometrics, Digital Innovation, and Social Justice.* With tests and measures widely used for decision-making, ranking, and policy purposes, to what extent are we measuring unintended constructs such as conformity to expected cultural norms? By observing the testing situation, Dr. Zumbo's work aims to identify clues about how tests are constructed, understood, and performed as a social cause.

Details regarding Dr. Zumbo's talk will be available soon … keep an eye out for the talk at canadianquantpsych.ca, @qm_cpa, or qm_cpa@yorku.ca.

# We Have a Website!!

Thanks to our Communications Director, Oscar Olvera Astivia, the QM Section now has a website at: http://canadianquantpsych.ca. Currently you can find details regarding QM Section Awards, a list of QM Journals, past *Psychostatistics* newsletters, etc. Don't forget to also follow our Twitter account, @qm_cpa, and if you are not a member of our listserv (qm_cpa@yorku.ca) please send an email to Rob Cribbie (cribbie@yorku.ca) to get added so you don't miss any QM Section news.

# QM Graduate Programs in Canada

### University of Alberta
Centre for Research in Applied Measurement and Evaluation
https://sites.google.com/ualberta.ca/crame
Contact: Dr. Mark Gierl
Email: mark.gierl@ualberta.ca

### University of British Columbia
MA/PhD, Quantitative Methods
https://psych.ubc.ca/graduate/research-areas/quantitative-methods/
Contact: Victoria Savalei
Email: vsavalei@psych.ubc.ca

MA/PhD, Measurement, Evaluation, and Research Methodology
http://ecps.educ.ubc.ca/measurement-evaluation-and-research-methodology/
Contact: Amery Wu
Email: amery.wu@ubc.ca

### Carleton University
MA, Specialization in Data Science
PhD, Concentration in Quantitative Methods
https://calendar.carleton.ca/grad/gradprograms/psychology/
Contact: Michael Wohl
Email: michael.wohl@carleton.ca

### University of Manitoba
MA/PhD Methodology
http://home.cc.umanitoba.ca/~psycarea/programs/quantitative/index.html
Contact: Johnson Li
Email: johnson.li@umanitoba.ca

### McGill University
PhD, Quantitative Psychology and Modeling
http://www.mcgill.ca/psychology/research-0/quantitative-modelling
Contact: Heungsun Hwang
Email: heungsun.hwang@mcgill.ca

### Simon Fraser University
MA/PhD, Quantitative Methods
https://www.sfu.ca/psychology/areas/hqt.html
Contact: Rachel Fouladi
Email: rfouladi@sfu.ca

### Trent University
MSc, Applied Modeling and Quantitative Methods
https://www.trentu.ca/amod/
Contact: Dr. James Parker
Email: jparker@trentu.ca

### York University
MA/PhD, Quantitative Methods
http://qm.info.yorku.ca/
Contact: David Flora
Email: dflora@yorku.ca

> If there are any programs that we missed that fall under the *Quantitative Methods for Psychology* umbrella, please contact any Executive member

> Numerous resources related to the study of quantitative methods for psychology can be found on the APA Website:
>
> *http://www.apa.org/research/tools/quantitative*
>
> There you will find, among other things, that, relative to other areas of psychology, there is a much greater chance of getting a job with a PhD in Quantitative Methods.

# Cathy Zhang & Victoria Savalei: Winners of the 2019 *Quantitative Methods Research Award*

The QM Section recently began offering an award to recognize an outstanding research contribution on Quantitative Methods for Psychology by a Canadian (or affiliated) researcher. Specifically (from the by-laws):

*This annual (calendar year) award will recognize excellence in a research study focusing on quantitative methods for psychology and published in a refereed scientific journal by a researcher in Canada (i.e., a researcher working at an institution in Canada, or an individual from outside Canada who is a member of the Section). The publication date of the article must match the award year.*

The 2019 winners of the *QM Research Award* were Cathy Zhang and Victoria Savalei for their article titled "Examining the effect of missing data on RMSEA and CFI under normal theory full-information maximum likelihood". Their article appeared in *Structural Equation Modeling* in 2019. The runners-up were Johnson Li and Rory Waisman for their article titled "Probability of bivariate superiority: A non-parametric common-language statistic for detecting bivariate relationships" which appeared in *Behavior Research Methods* in 2019.

Congratulations to our winners! The 2020 winner will be announced at the QM Section Business Meeting.

## QM Laugh 2



## QM Section Executive: Elections

Elections for QM Section positions on the Executive Committee occur annually at the QM Business Meeting during the CPA Convention. Positions are available for both students and faculty/researchers. If you are interested in running for a position, or if you would like to nominate someone for a position, you can email executive members or nominations will also be accepted during the Business Meeting.

A list of available executive positions in the QM section can be found on pages 8 and 9.

# Meet Your 2020–2021 QM Section Executive Team

## Chair:
Andrea Howard
Department of Psychology
Carleton University
*andrea.howard@carleton.ca*



It has been very unfortunate that the 2020 and 2021 CPA Conventions had to be held virtually. However, this also presents some opportunities, such as having more external speakers and limiting travelling costs for attendees. Hope to see you at Virtual CPA 2021!

## Chair-Elect:
Rob Cribbie
Department of Psychology
York University
*cribbie@yorku.ca*



### Special Points of Interest

The QM Section of CPA was formed in 2013.

There are currently 45 members of the QM Section … 18 student and 27 regular members. Don't forget to sign up for the section when you complete your CPA membership.

Note: CPA 2022 is in Calgary.

## Past Chair:
Don Sharpe
Department of Psychology
University of Regina
sharped@uregina.ca

## Secretary/Treasurer:

Alyssa Counsell
Department of Psychology
Ryerson University
*a.counsell@ryerson.ca*

**Want to Get Involved?**

Email any of the Executive Committee members - we'd love to have you!

## Communications Director:

Oscar Olvera Astivia
College of Education
University of Washington
*oastivia@uw.edu*

**2021 Virtual CPA**

Keep an eye on http://cpa.ca/convention for details regarding the *virtual* CPA Convention to be held online in June. There are a number of QM presentations that will take place between June 15 and June 18.

## Student Representative:

Udi Alter
Department of Psychology
Ryerson University
*udi.alter@ryerson.ca*