TEACHING REPRODUCIBLE DATA ANALYSIS IN R

SCHOOL OF PSYCHOLOGY TEACHING TEAM

It’s not just about changing what you teach…

it’s about building a community

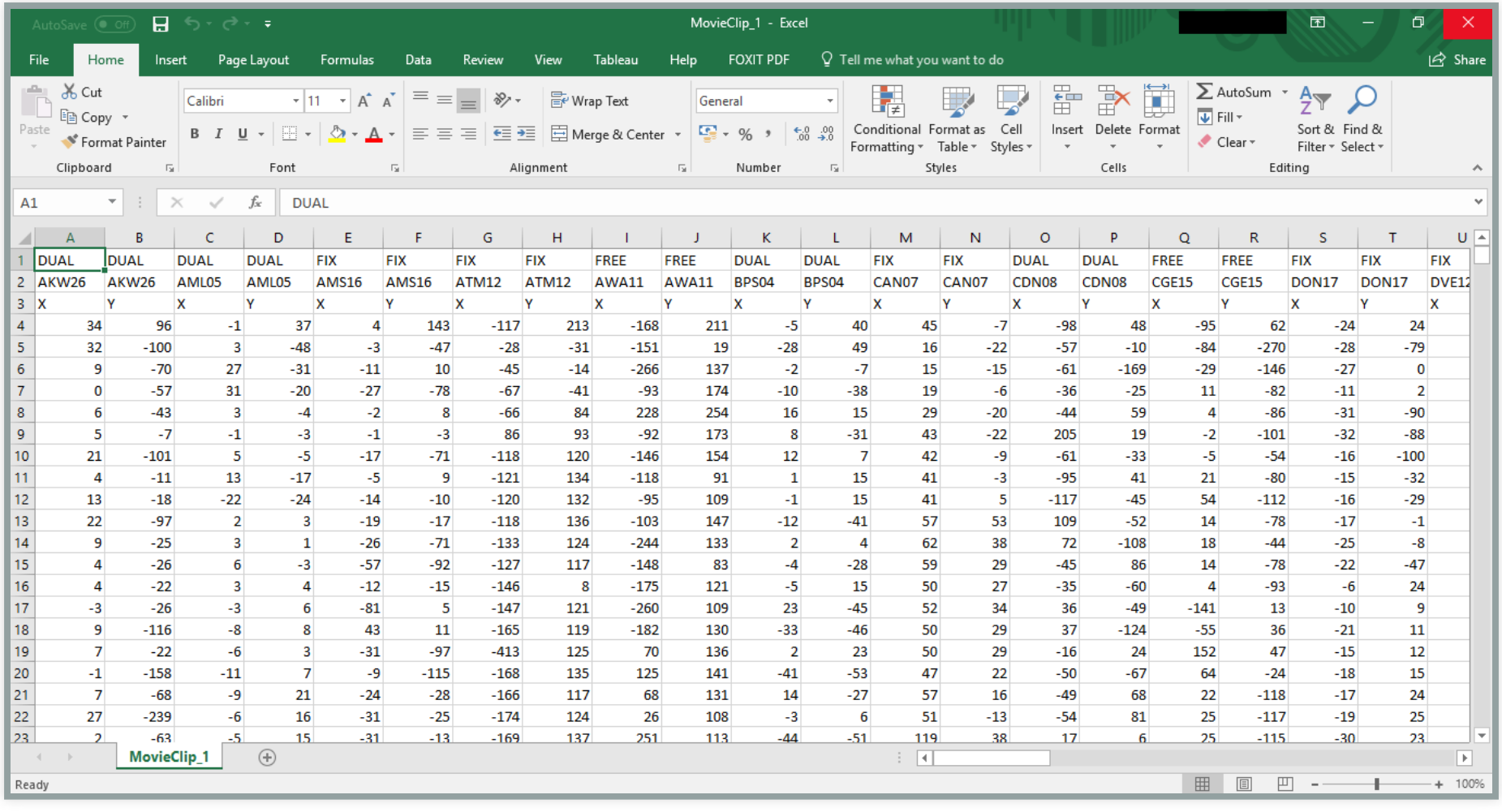
It's not just about R, it's about:

- building confidence and independence
- enabling more efficient data analysis workflows
- instilling values of reproducibility and transparency

WHY, WHAT, AND HOW

- our backstory
- what flavor of R to teach
- how to teach it

WHY?



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	DUAL	DUAL	DUAL	DUAL	FIX	FIX	FIX	FIX	FREE	FREE	DUAL	DUAL	FIX	FIX	DUAL	DUAL	FREE	FREE	FIX	FIX	FIX
2	AKW26	AKW26	AML05	AML05	AMS16	AMS16	ATM12	ATM12	AWA11	AWA11	BPS04	BPS04	CAN07	CAN07	CDN08	CDN08	CGE15	CGE15	DON17	DON17	DVE12
3	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X
4	34	96	-1	37	4	143	-117	213	-168	211	-5	40	45	-7	-98	48	-95	62	-24	24	
5	32	-100	3	-48	-3	-47	-28	-31	-151	19	-28	49	16	-22	-57	-10	-84	-270	-28	-79	
6	9	-70	27	-31	-11	10	-45	-14	-266	137	-2	-7	15	-15	-61	-169	-29	-146	-27	0	
7	0	-57	31	-20	-27	-78	-67	-41	-93	174	-10	-38	19	-6	-36	-25	11	-82	-11	2	
8	6	-43	3	-4	-2	8	-66	84	228	254	16	15	29	-20	-44	59	4	-86	-31	-90	
9	5	-7	-1	-3	-1	-3	86	93	-92	173	8	-31	43	-22	205	19	-2	-101	-32	-88	
10	21	-101	5	-5	-17	-71	-118	120	-146	154	12	7	42	-9	-61	-33	-5	-54	-16	-100	
11	4	-11	13	-17	-5	9	-121	134	-118	91	1	15	41	-3	-95	41	21	-80	-15	-32	
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13	22	-97	2	3	-19	-17	-118	136	-103	147	-12	-41	57	53	109	-52	14	-78	-17	-1	
14	9	-25	3	1	-26	-71	-133	124	-244	133	2	4	62	38	72	-108	18	-44	-25	-8	
15	4	-26	6	-3	-57	-92	-127	117	-148	83	-4	-28	59	29	-45	86	14	-78	-22	-47	
16	4	-22	3	4	-12	-15	-146	8	-175	121	-5	15	50	27	-35	-60	4	-93	-6	24	
17	-3	-26	-3	6	-81	5	-147	121	-260	109	23	-45	52	34	36	-49	-141	13	-10	9	
18	9	-116	-8	8	43	11	-165	119	-182	130	-33	-46	50	29	37	-124	-55	36	-21	11	
19	7	-22	-6	3	-31	-97	-413	125	70	136	2	23	50	29	-16	24	152	47	-15	12	
20	-1	-158	-11	7	-9	-115	-168	135	125	141	-41	-53	47	22	-50	-67	64	-24	-18	15	
21	7	-68	-9	21	-24	-28	-166	117	68	131	14	-27	57	16	-49	68	22	-118	-17	24	
22	27	-239	-6	16	-31	-25	-174	124	26	108	-3	6	51	-13	-54	81	25	-117	-19	25	
23	2	-63	-5	15	-31	-13	-169	137	251	113	-44	-51	119	38	17	6	25	-115	-30	23	

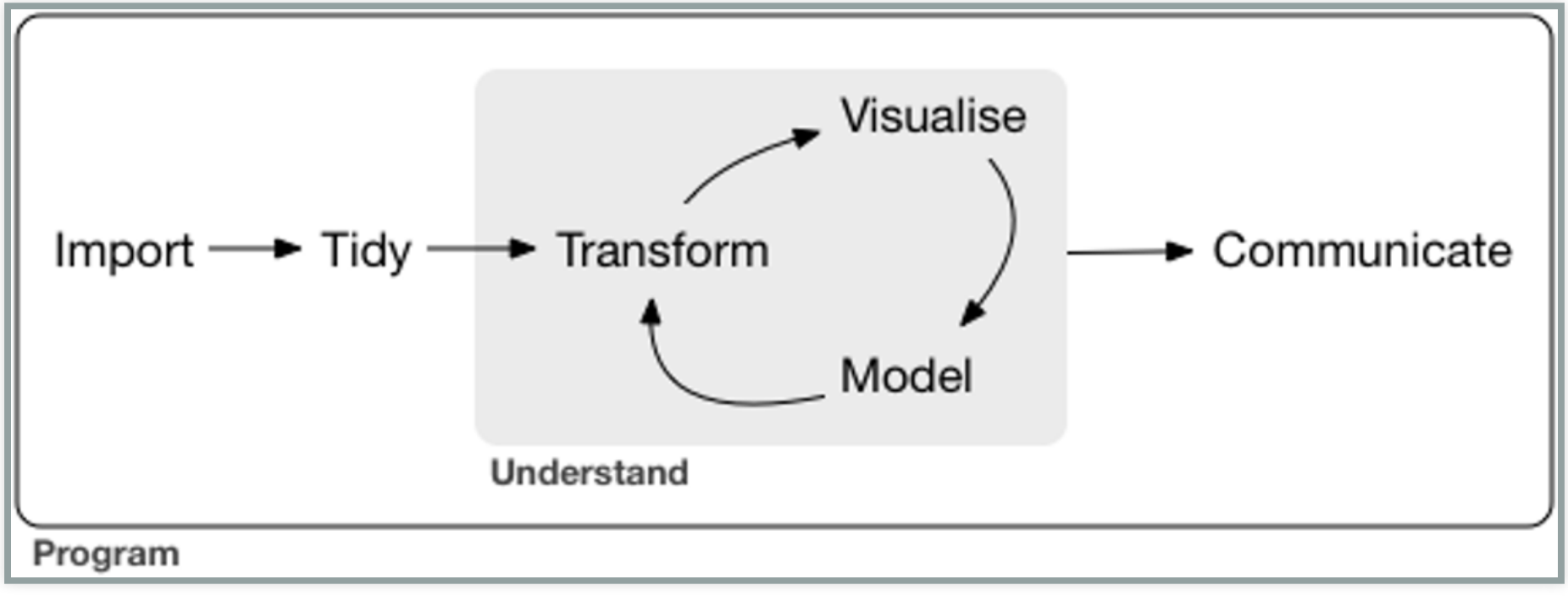
"I want to have the data file so there are only 4 columns - PARTICIPANT CODE, CONDITION, X, Y."

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	Id	Gender	Age	Participate	I often notice small	I usually concentrat	I find it easy to do	If there is an interr	I find it easy to rea	I know how to tell if	When I'm reading a	I like to collect
3	16	Male	20	1	Slightly Disagree	Definitely Agree	Slightly Disagree	Definitely Disagree	Slightly Agree	Slightly Agree	Slightly Agree	Definitely Disa
4	17	Male	40	1	Definitely Agree	Slightly Agree	Slightly Agree	Definitely Agree	Definitely Agree	Definitely Agree	Slightly Agree	Slightly Disagr
5	18	Male	33	1	Definitely Agree	Definitely Agree	Slightly Agree	Definitely Agree	Definitely Agree	Definitely Agree	Slightly Agree	Definitely Agre
6	19	Male	18	1	Definitely Agree	Definitely Agree	Definitely Agree	Slightly Agree	Definitely Agree	Definitely Agree	Slightly Disagree	Slightly Disagr
7	20	Male	24	1	Definitely Disagree	Slightly Disagree	Definitely Agree	Slightly Agree	Slightly Agree	Slightly Agree	Slightly Disagree	Slightly Disagr
8	21	Female	42	1	Slightly Disagree	Slightly Disagree	Definitely Agree	Slightly Agree	Slightly Disagree	Slightly Agree	Definitely Disagree	Definitely Disa
9	22	Female	19	1	Slightly Agree	Definitely Agree	Slightly Disagree	Slightly Disagree	Definitely Disagree	Slightly Agree	Definitely Disagree	Slightly Agree
10	28	Female	49	1	Slightly Disagree	Slightly Disagree	Slightly Agree	Slightly Agree	Slightly Agree	Slightly Agree	Slightly Disagree	Slightly Disagr
11	29	Female	18	1	Slightly Agree	Slightly Disagree	Definitely Agree	Definitely Agree	Definitely Agree	Definitely Agree	Slightly Disagree	Slightly Agree
12	31	Male	18	1	Slightly Agree	Slightly Disagree	Slightly Agree	Slightly Agree	Slightly Agree	Slightly Agree	Slightly Disagree	Definitely Disa
13	34	Female	32	1	Definitely Agree	Slightly Agree	Definitely Agree	Definitely Agree	Slightly Agree	Slightly Agree	Slightly Disagree	Definitely Disa
14	35	Female	18	1	Slightly Agree	Slightly Disagree	Definitely Agree	Definitely Agree	Definitely Agree	Definitely Agree	Slightly Agree	Definitely Agre
15	39	Female	20	1	Slightly Agree	Slightly Agree	Definitely Agree	Slightly Disagree	Definitely Agree	Definitely Agree	Slightly Disagree	Definitely Disa

Id	AQ	Gender	Age	Participate
(int)	(dbl)	(chr)	(int)	(int)
52	9	Male	25	0
55	8	Female	23	1
86	8	Male	77	1
99	8	Male	25	0
46	7	Female	21	1
74	7	Female	48	1
22	6	Female	19	1
40	5	Male	39	1
45	5	Female	58	1
51	5	Female	20	1

http://talklab.psy.gla.ac.uk/r_training/scoring_the_AQ/

DATA COMPREHENSION

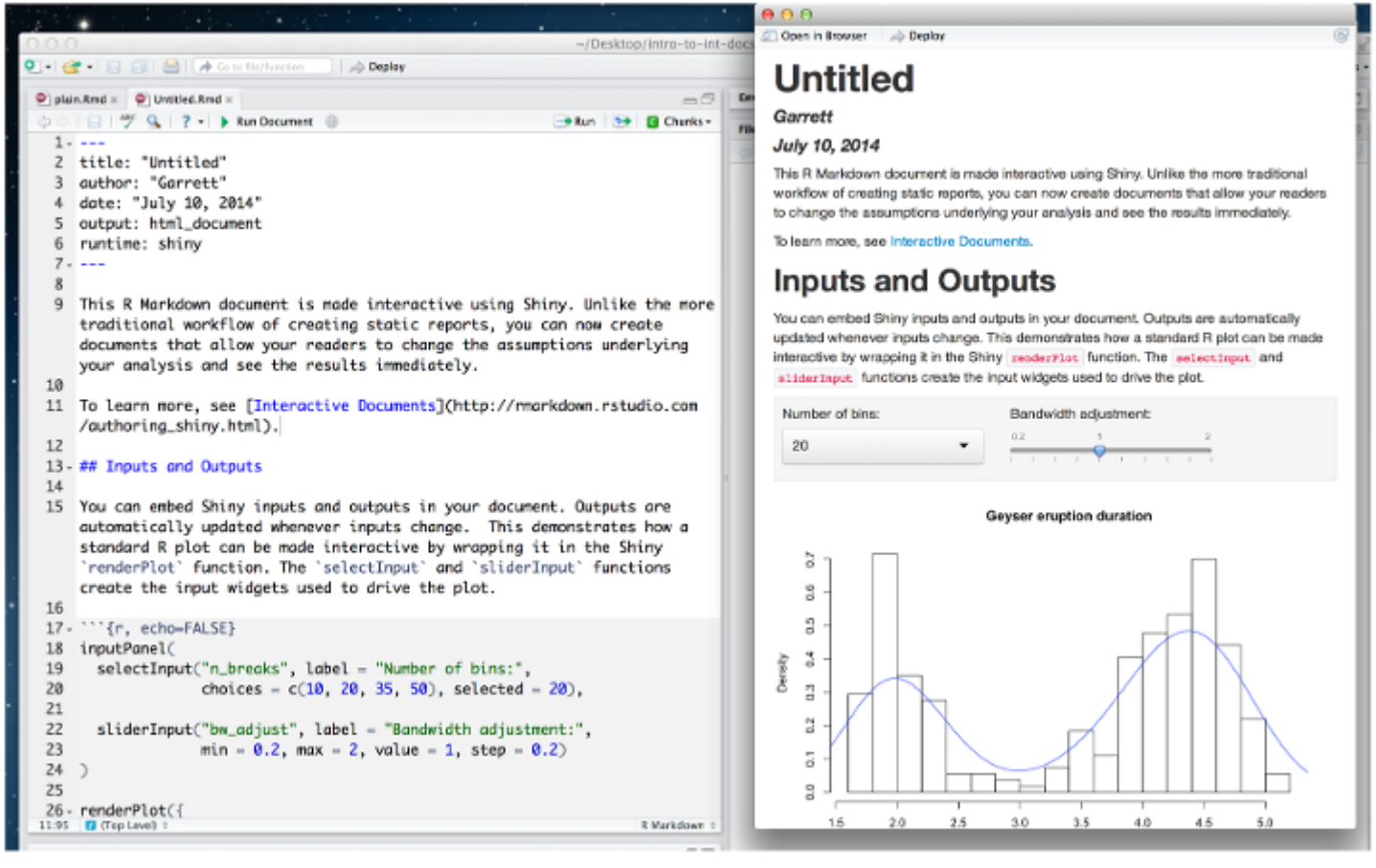


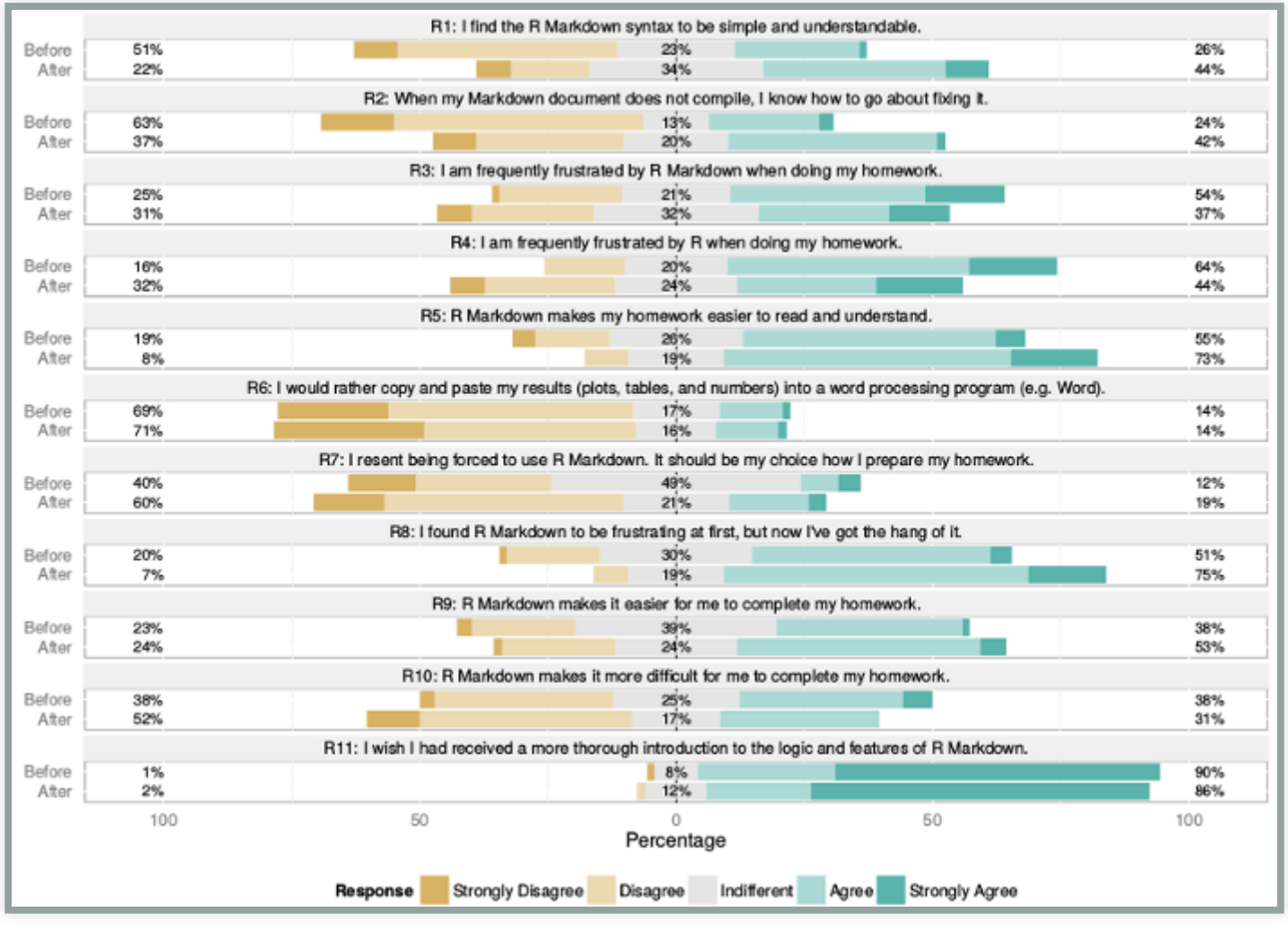
Grolemund & Wickham, R for Data Science

WHAT?

WHAT FLAVOR OF R?

REPRODUCIBLE REPORTS IN RMARKDOWN





Baumer, Cetinkaya-Rundel, Bray, Loi, & Horton (2014)

TIDYVERSE FIRST!

- **Tidy Data**
  - Rows = observations
  - Columns = variables
  - Table = observation unit
- **Tidy Tools**
  - tidy input –> tidy output
- **Visualization with `ggplot2`**

http://varianceexplained.org/r/teach-tidyverse/

THE "WICKHAM SIX" DPLYR VERBS

Six verbs cover 90% of data tidying - Hadley Wickham

`select()`	choose columns
`filter()`	choose rows
`mutate()`	create new columns
`arrange()`	sort the rows
`group_by()`	establish groups
`summarise()`	summarise data/groups

- also: combining data sources, restructuring data

THE PROGRAMME

Y1	R/RStudio/RMarkdown, data import, tidying, viz, probability & descriptive stats
Y2	sampling distributions, GLM, correlation, regression, t-test, data simulation
Y3	mixed-model ANOVA, multilevel regression
Y4	advanced topics (factor analysis, psychometrics, etc)

HOW?

MAKING THE TRANSITION

- *Ongoing*: stats journal club
- R/RStudio training sessions
- Phase in gradually
  - translate descriptive/inferential stats materials into R
  - introduce data wrangling labs at intro level
- Support staff and students using slack.com messaging
  - separate workspaces for staff and students

HOW DO WE GET STAFF TO BUY IN TO USING R?

SOLUTION: EMBED R INTO TEACHING

- generating academic web pages on github
- using R in marking
- tracking student engagement with Moodle logs
- make exams with the `exams` package
- generate self-guided web exercises with RMarkdown and `webex`
- semi-automated assessment/feedback on RMarkdown-based assignments with `assessr`

WHY? *reproducibility, efficiency, competence, confidence*

WHAT? *data wrangling, R + RStudio + RMarkdown + tidyverse*

HOW? *gradually, embed R in everyday practice*

WHEN? *ASAP!*

WHERE? *EVERYWHERE!*

TODAY'S SCHEDULE

09:00 - 09:30	Coffee and chat (58 Hillhead Street)
09:30 - 10:00	Introduction and philosophy
10:00 - 10:30	Our approach
10:30 - 10:45	Coffee and chat
10:45 - 11:15	Practicalities
11:15 - 11:45	Staff skill development
11:45 - 12:15	Student engagement
12:15 - 13:00	Lunch (move to Boyd Orr)
13:00 - 14:00	Lab demo
14:00 - 14:30	Coffee and questions
14:30 - 15:00	Assessment with assessr
15:00 - 15:30	Web exercises with webex
15:30 - 16:30	Wine and discussion