Transforming Ag data with dplyr

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1 Description

This lesson introduces the concept of tidy data, and a few basic data wrangling techniques using `dplyr` package. Today, we are using `dplyr` and datasets from the `agridat` package. If you don't have them installed, you can do so by running:

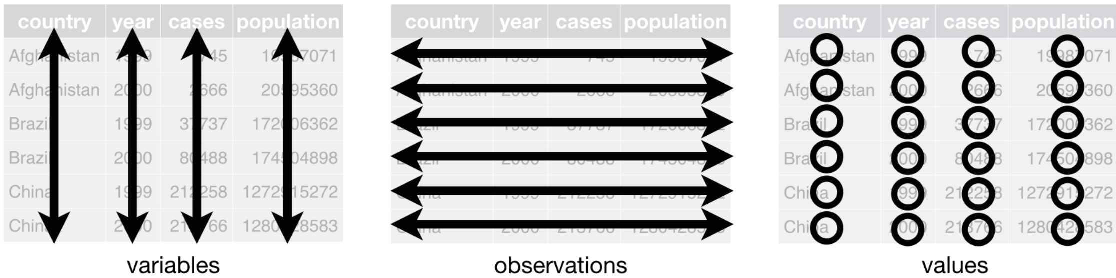
1.1 Required packages for today

```
library(pacman)
p_load(agridat) # Agridat datasets
p_load(dplyr) # dplyr for data wrangling
p_load(skimr) # skimr for quick exploration of the data
```

2 Why TIDY?

Well, from the hand of Tidyverse, the "tidy data" framework changed the way we code and work in R for data science. Tidy datasets are easy to manipulate, model and visualize, and have a specific structure (Wickham 2014):

- Each variable is a column,
- Each observation is a row, and
- Each value have its own cell.



Tidy-data structure. Following three rules makes a dataset tidy: variables are in columns, observations are in rows, and values are in cells. Source: (Wickham and Grolemund 2017).

Example of tidy data:

```r
# Example of tidy data
tidy_data <- data.frame(
  subject = c(1, 2, 3),
  gender = c("M", "F", "F"),
  score = c(90, 95, 88)
)

tidy_data
```

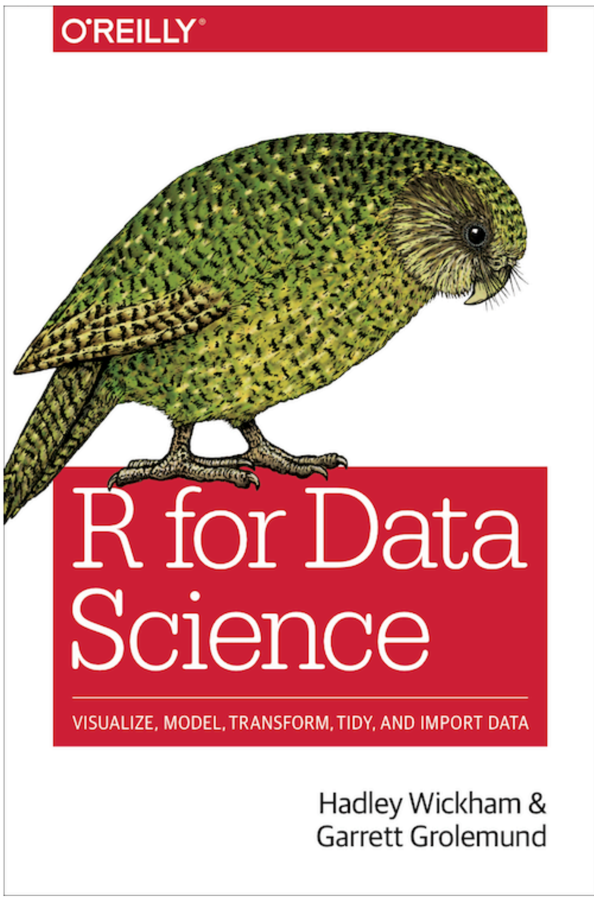
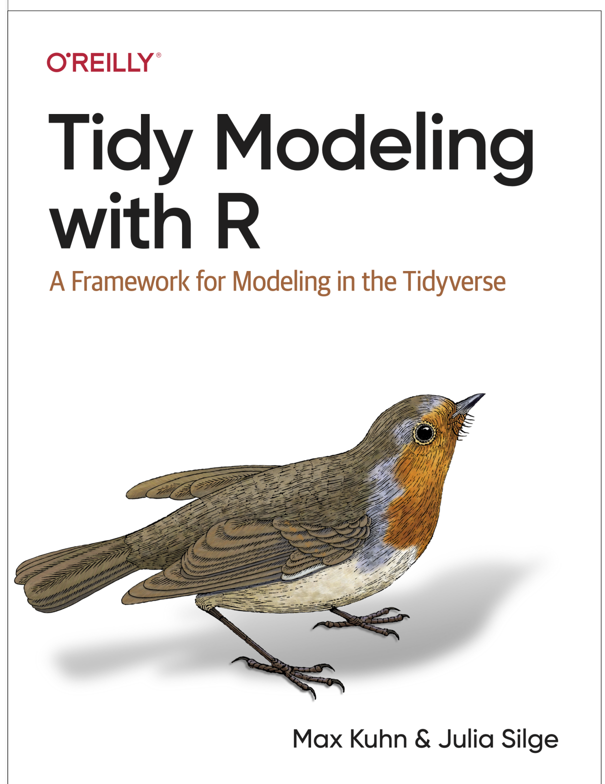
```
  subject gender score
1       1      M    90
2       2      F    95
3       3      F    88
```

2.0.1 Free HTML books

2.1 What is a Data Frame?

A data frame is a two-dimensional table-like structure in R, where columns can contain different types of data (e.g., numeric, character). It is the default structure for datasets loaded from CSV files or data packages.

2.1.1 open a data frame


O'REILLY
R for Data Science
VISUALIZE, MODEL, TRANSFORM, TIDY, AND IMPORT DATA
Hadley Wickham &
Garrett Grolemund

O'REILLY
Tidy Modeling with R
A Framework for Modeling in the Tidyverse
Max Kuhn & Julia Silge

```r
# Load the wheat dataset from agricolae (which is a data frame)
wheat_data <- agridat::payne.wheat

# Check the structure of the data frame
str(wheat_data)
```

```
'data.frame':	480 obs. of  4 variables:
 $ rotation: Factor w/ 6 levels "AB","AF","Lc3",..: 1 1 1 1 2 2 2 2 5 5 ...
 $ nitro   : int  0 70 140 210 0 70 140 210 0 70 ...
 $ year    : int  1981 1981 1981 1981 1981 1981 1981 1981 1981 1981 ...
 $ yield   : num  3.84 6.59 7.49 7.39 3.06 6.32 7.61 7.78 5.82 7.52 ...
```

2.2 What is a Tibble?

A tibble is a modern version of a data frame, introduced by the tibble package. It offers several improvements:

- Tibbles don't convert characters to factors by default.
- Printing is more concise and doesn't overwhelm you with too much data.
- Tibbles are more explicit with column types when printed.

2.2.1 create a tibble

```r
# Convert the wheat data frame to a tibble
wheat_tibble <- as_tibble(wheat_data)

# Check the structure of the tibble
wheat_tibble
```

```
# A tibble: 480 x 4
   rotation nitro  year yield
   <fct>    <int> <int> <dbl>
 1 AB           0  1981  3.84
 2 AB          70  1981  6.59
 3 AB         140  1981  7.49
 4 AB         210  1981  7.39
 5 AF           0  1981  3.06
 6 AF          70  1981  6.32
```

```
 7 AF          140  1981  7.61
 8 AF          210  1981  7.78
 9 Ln3           0  1981  5.82
10 Ln3          70  1981  7.52
# i 470 more rows
```

2.3 iii. Key Differences between Data Frames and Tibbles

```
1.  **Printing**:
```

• Data Frames print the entire dataset unless you limit the number of rows. No information about column types is displayed. • Tibbles print only the first 10 rows and automatically show column types.

2.3.1 Example:

```r
# Print the entire data frame
print(wheat_data)
```

```
    rotation nitro year yield
1         AB     0 1981  3.84
2         AB    70 1981  6.59
3         AB   140 1981  7.49
4         AB   210 1981  7.39
5         AF     0 1981  3.06
6         AF    70 1981  6.32
7         AF   140 1981  7.61
8         AF   210 1981  7.78
9        Ln3     0 1981  5.82
10       Ln3    70 1981  7.52
11       Ln3   140 1981  8.12
12       Ln3   210 1981  7.40
13       Ln8     0 1981  4.71
14       Ln8    70 1981  6.52
15       Ln8   140 1981  8.03
16       Ln8   210 1981  7.83
17       Lc3     0 1981  5.35
18       Lc3    70 1981  6.70
19       Lc3   140 1981  7.69
```

20	Lc3	210	1981	7.53
21	Lc8	0	1981	6.47
22	Lc8	70	1981	7.84
23	Lc8	140	1981	7.98
24	Lc8	210	1981	7.68
25	AB	0	1982	4.47
26	AB	70	1982	6.38
27	AB	140	1982	7.82
28	AB	210	1982	8.13
29	AF	0	1982	4.30
30	AF	70	1982	6.82
31	AF	140	1982	8.16
32	AF	210	1982	8.52
33	Ln3	0	1982	5.37
34	Ln3	70	1982	7.91
35	Ln3	140	1982	7.53
36	Ln3	210	1982	8.46
37	Ln8	0	1982	5.55
38	Ln8	70	1982	8.04
39	Ln8	140	1982	8.27
40	Ln8	210	1982	7.31
41	Lc3	0	1982	5.16
42	Lc3	70	1982	7.81
43	Lc3	140	1982	8.38
44	Lc3	210	1982	7.40
45	Lc8	0	1982	6.56
46	Lc8	70	1982	8.36
47	Lc8	140	1982	8.60
48	Lc8	210	1982	8.41
49	AB	0	1983	4.11
50	AB	70	1983	6.28
51	AB	140	1983	8.70
52	AB	210	1983	8.17
53	AF	0	1983	3.76
54	AF	70	1983	6.79
55	AF	140	1983	8.50
56	AF	210	1983	9.43
57	Ln3	0	1983	3.86
58	Ln3	70	1983	7.05
59	Ln3	140	1983	8.06
60	Ln3	210	1983	8.28
61	Ln8	0	1983	4.45
62	Ln8	70	1983	7.23

63	Ln8	140	1983	7.48
64	Ln8	210	1983	6.93
65	Lc3	0	1983	6.36
66	Lc3	70	1983	9.67
67	Lc3	140	1983	9.34
68	Lc3	210	1983	8.40
69	Lc8	0	1983	7.39
70	Lc8	70	1983	9.64
71	Lc8	140	1983	8.80
72	Lc8	210	1983	8.66
73	AB	0	1984	3.66
74	AB	70	1984	6.56
75	AB	140	1984	7.74
76	AB	210	1984	9.41
77	AF	0	1984	4.28
78	AF	70	1984	8.94
79	AF	140	1984	9.12
80	AF	210	1984	9.35
81	Ln3	0	1984	4.92
82	Ln3	70	1984	7.66
83	Ln3	140	1984	9.75
84	Ln3	210	1984	10.35
85	Ln8	0	1984	5.46
86	Ln8	70	1984	8.68
87	Ln8	140	1984	9.20
88	Ln8	210	1984	10.33
89	Lc3	0	1984	7.18
90	Lc3	70	1984	11.06
91	Lc3	140	1984	10.52
92	Lc3	210	1984	9.88
93	Lc8	0	1984	7.51
94	Lc8	70	1984	9.66
95	Lc8	140	1984	11.04
96	Lc8	210	1984	9.36
97	AB	0	1985	2.39
98	AB	70	1985	5.90
99	AB	140	1985	7.76
100	AB	210	1985	8.62
101	AF	0	1985	2.03
102	AF	70	1985	5.46
103	AF	140	1985	7.72
104	AF	210	1985	9.20
105	Ln3	0	1985	4.24

106	Ln3	70	1985	7.26
107	Ln3	140	1985	8.26
108	Ln3	210	1985	9.69
109	Ln8	0	1985	4.07
110	Ln8	70	1985	6.98
111	Ln8	140	1985	8.39
112	Ln8	210	1985	8.55
113	Lc3	0	1985	4.97
114	Lc3	70	1985	7.64
115	Lc3	140	1985	9.57
116	Lc3	210	1985	8.84
117	Lc8	0	1985	4.44
118	Lc8	70	1985	8.08
119	Lc8	140	1985	8.76
120	Lc8	210	1985	10.19
121	AB	0	1986	4.17
122	AB	70	1986	6.91
123	AB	140	1986	7.21
124	AB	210	1986	8.53
125	AF	0	1986	4.08
126	AF	70	1986	5.08
127	AF	140	1986	6.32
128	AF	210	1986	7.88
129	Ln3	0	1986	3.36
130	Ln3	70	1986	5.65
131	Ln3	140	1986	6.62
132	Ln3	210	1986	6.05
133	Ln8	0	1986	4.68
134	Ln8	70	1986	6.55
135	Ln8	140	1986	7.20
136	Ln8	210	1986	6.84
137	Lc3	0	1986	6.14
138	Lc3	70	1986	7.15
139	Lc3	140	1986	6.89
140	Lc3	210	1986	6.20
141	Lc8	0	1986	6.09
142	Lc8	70	1986	7.31
143	Lc8	140	1986	6.85
144	Lc8	210	1986	6.75
145	AB	0	1987	4.39
146	AB	70	1987	6.18
147	AB	140	1987	6.75
148	AB	210	1987	7.84

149	AF	0	1987	3.02
150	AF	70	1987	5.56
151	AF	140	1987	6.60
152	AF	210	1987	6.43
153	Ln3	0	1987	4.41
154	Ln3	70	1987	6.55
155	Ln3	140	1987	7.59
156	Ln3	210	1987	7.13
157	Ln8	0	1987	4.80
158	Ln8	70	1987	6.74
159	Ln8	140	1987	7.86
160	Ln8	210	1987	7.00
161	Lc3	0	1987	5.51
162	Lc3	70	1987	7.24
163	Lc3	140	1987	7.74
164	Lc3	210	1987	7.61
165	Lc8	0	1987	5.26
166	Lc8	70	1987	7.48
167	Lc8	140	1987	8.31
168	Lc8	210	1987	8.13
169	AB	0	1988	2.98
170	AB	70	1988	6.28
171	AB	140	1988	6.77
172	AB	210	1988	6.20
173	AF	0	1988	3.09
174	AF	70	1988	6.60
175	AF	140	1988	6.63
176	AF	210	1988	6.61
177	Ln3	0	1988	4.01
178	Ln3	70	1988	6.77
179	Ln3	140	1988	7.12
180	Ln3	210	1988	6.14
181	Ln8	0	1988	4.34
182	Ln8	70	1988	6.73
183	Ln8	140	1988	7.46
184	Ln8	210	1988	7.23
185	Lc3	0	1988	5.68
186	Lc3	70	1988	7.39
187	Lc3	140	1988	7.54
188	Lc3	210	1988	7.51
189	Lc8	0	1988	5.26
190	Lc8	70	1988	7.87
191	Lc8	140	1988	6.94

192	Lc8	210	1988	7.06
193	AB	0	1989	1.16
194	AB	70	1989	3.94
195	AB	140	1989	4.58
196	AB	210	1989	4.74
197	AF	0	1989	2.80
198	AF	70	1989	4.92
199	AF	140	1989	5.17
200	AF	210	1989	5.82
201	Ln3	0	1989	4.04
202	Ln3	70	1989	5.94
203	Ln3	140	1989	6.10
204	Ln3	210	1989	6.04
205	Ln8	0	1989	3.77
206	Ln8	70	1989	5.58
207	Ln8	140	1989	5.56
208	Ln8	210	1989	4.91
209	Lc3	0	1989	5.45
210	Lc3	70	1989	6.28
211	Lc3	140	1989	6.12
212	Lc3	210	1989	5.81
213	Lc8	0	1989	4.91
214	Lc8	70	1989	6.69
215	Lc8	140	1989	6.39
216	Lc8	210	1989	5.06
217	AB	0	1990	1.47
218	AB	70	1990	4.94
219	AB	140	1990	5.83
220	AB	210	1990	6.33
221	AF	0	1990	1.38
222	AF	70	1990	5.72
223	AF	140	1990	6.30
224	AF	210	1990	5.18
225	Ln3	0	1990	1.73
226	Ln3	70	1990	4.94
227	Ln3	140	1990	5.43
228	Ln3	210	1990	6.17
229	Ln8	0	1990	2.62
230	Ln8	70	1990	5.79
231	Ln8	140	1990	5.08
232	Ln8	210	1990	5.25
233	Lc3	0	1990	3.59
234	Lc3	70	1990	6.06

235	Lc3	140	1990	7.20
236	Lc3	210	1990	6.42
237	Lc8	0	1990	3.31
238	Lc8	70	1990	6.51
239	Lc8	140	1990	6.65
240	Lc8	210	1990	6.99
241	AB	0	1991	4.48
242	AB	70	1991	8.56
243	AB	140	1991	9.94
244	AB	210	1991	10.23
245	AF	0	1991	3.46
246	AF	70	1991	8.00
247	AF	140	1991	9.75
248	AF	210	1991	10.57
249	Ln3	0	1991	6.75
250	Ln3	70	1991	8.85
251	Ln3	140	1991	9.96
252	Ln3	210	1991	10.41
253	Ln8	0	1991	5.94
254	Ln8	70	1991	8.83
255	Ln8	140	1991	9.64
256	Ln8	210	1991	9.75
257	Lc3	0	1991	6.47
258	Lc3	70	1991	9.37
259	Lc3	140	1991	10.46
260	Lc3	210	1991	10.48
261	Lc8	0	1991	6.08
262	Lc8	70	1991	8.81
263	Lc8	140	1991	9.63
264	Lc8	210	1991	10.10
265	AB	0	1992	6.31
266	AB	70	1992	7.84
267	AB	140	1992	7.21
268	AB	210	1992	6.81
269	AF	0	1992	3.82
270	AF	70	1992	8.05
271	AF	140	1992	8.21
272	AF	210	1992	7.59
273	Ln3	0	1992	2.73
274	Ln3	70	1992	6.47
275	Ln3	140	1992	7.49
276	Ln3	210	1992	7.26
277	Ln8	0	1992	4.19

278	Ln8	70	1992	7.17
279	Ln8	140	1992	7.54
280	Ln8	210	1992	6.67
281	Lc3	0	1992	6.33
282	Lc3	70	1992	7.48
283	Lc3	140	1992	6.13
284	Lc3	210	1992	4.79
285	Lc8	0	1992	7.11
286	Lc8	70	1992	6.65
287	Lc8	140	1992	6.45
288	Lc8	210	1992	6.14
289	AB	0	1993	3.11
290	AB	70	1993	5.92
291	AB	140	1993	5.89
292	AB	210	1993	6.63
293	AF	0	1993	2.86
294	AF	70	1993	5.79
295	AF	140	1993	6.72
296	AF	210	1993	7.37
297	Ln3	0	1993	3.13
298	Ln3	70	1993	5.40
299	Ln3	140	1993	6.60
300	Ln3	210	1993	6.52
301	Ln8	0	1993	3.42
302	Ln8	70	1993	5.16
303	Ln8	140	1993	6.47
304	Ln8	210	1993	6.55
305	Lc3	0	1993	5.58
306	Lc3	70	1993	7.01
307	Lc3	140	1993	7.69
308	Lc3	210	1993	7.91
309	Lc8	0	1993	6.08
310	Lc8	70	1993	7.03
311	Lc8	140	1993	7.20
312	Lc8	210	1993	7.69
313	AB	0	1994	0.93
314	AB	70	1994	3.94
315	AB	140	1994	4.04
316	AB	210	1994	3.51
317	AF	0	1994	1.80
318	AF	70	1994	5.32
319	AF	140	1994	8.08
320	AF	210	1994	8.55

321	Ln3	0	1994	4.76
322	Ln3	70	1994	6.16
323	Ln3	140	1994	7.35
324	Ln3	210	1994	7.14
325	Ln8	0	1994	3.64
326	Ln8	70	1994	5.14
327	Ln8	140	1994	7.00
328	Ln8	210	1994	7.16
329	Lc3	0	1994	5.06
330	Lc3	70	1994	6.00
331	Lc3	140	1994	6.28
332	Lc3	210	1994	7.50
333	Lc8	0	1994	3.46
334	Lc8	70	1994	6.48
335	Lc8	140	1994	6.07
336	Lc8	210	1994	7.53
337	AB	0	1995	1.30
338	AB	70	1995	4.21
339	AB	140	1995	4.35
340	AB	210	1995	4.35
341	AF	0	1995	1.27
342	AF	70	1995	3.82
343	AF	140	1995	4.60
344	AF	210	1995	4.96
345	Ln3	0	1995	2.17
346	Ln3	70	1995	5.01
347	Ln3	140	1995	5.39
348	Ln3	210	1995	5.79
349	Ln8	0	1995	2.52
350	Ln8	70	1995	5.71
351	Ln8	140	1995	5.36
352	Ln8	210	1995	6.53
353	Lc3	0	1995	2.57
354	Lc3	70	1995	5.70
355	Lc3	140	1995	6.46
356	Lc3	210	1995	5.78
357	Lc8	0	1995	3.52
358	Lc8	70	1995	6.60
359	Lc8	140	1995	6.36
360	Lc8	210	1995	6.14
361	AB	0	1996	1.19
362	AB	70	1996	7.24
363	AB	140	1996	7.80

364	AB	210	1996	8.43
365	AF	0	1996	0.65
366	AF	70	1996	6.60
367	AF	140	1996	7.69
368	AF	210	1996	7.79
369	Ln3	0	1996	3.82
370	Ln3	70	1996	7.19
371	Ln3	140	1996	7.15
372	Ln3	210	1996	8.41
373	Ln8	0	1996	6.37
374	Ln8	70	1996	8.23
375	Ln8	140	1996	8.77
376	Ln8	210	1996	8.46
377	Lc3	0	1996	5.23
378	Lc3	70	1996	7.76
379	Lc3	140	1996	8.19
380	Lc3	210	1996	8.67
381	Lc8	0	1996	5.73
382	Lc8	70	1996	7.97
383	Lc8	140	1996	8.48
384	Lc8	210	1996	8.28
385	AB	0	1997	1.58
386	AB	70	1997	5.73
387	AB	140	1997	7.37
388	AB	210	1997	7.88
389	AF	0	1997	2.40
390	AF	70	1997	6.52
391	AF	140	1997	9.25
392	AF	210	1997	9.24
393	Ln3	0	1997	1.74
394	Ln3	70	1997	3.83
395	Ln3	140	1997	5.15
396	Ln3	210	1997	5.02
397	Ln8	0	1997	2.53
398	Ln8	70	1997	6.20
399	Ln8	140	1997	6.93
400	Ln8	210	1997	7.25
401	Lc3	0	1997	4.40
402	Lc3	70	1997	7.70
403	Lc3	140	1997	8.01
404	Lc3	210	1997	8.30
405	Lc8	0	1997	4.10
406	Lc8	70	1997	6.78

407	Lc8	140	1997	7.36
408	Lc8	210	1997	7.43
409	AB	0	1998	3.21
410	AB	70	1998	6.70
411	AB	140	1998	9.35
412	AB	210	1998	10.26
413	AF	0	1998	2.52
414	AF	70	1998	6.35
415	AF	140	1998	8.80
416	AF	210	1998	9.72
417	Ln3	0	1998	3.77
418	Ln3	70	1998	7.13
419	Ln3	140	1998	8.67
420	Ln3	210	1998	9.62
421	Ln8	0	1998	4.97
422	Ln8	70	1998	7.77
423	Ln8	140	1998	9.21
424	Ln8	210	1998	9.24
425	Lc3	0	1998	4.78
426	Lc3	70	1998	7.48
427	Lc3	140	1998	8.50
428	Lc3	210	1998	8.75
429	Lc8	0	1998	4.11
430	Lc8	70	1998	7.55
431	Lc8	140	1998	9.01
432	Lc8	210	1998	8.98
433	AB	0	1999	0.00
434	AB	70	1999	1.97
435	AB	140	1999	3.44
436	AB	210	1999	2.28
437	AF	0	1999	0.52
438	AF	70	1999	6.55
439	AF	140	1999	7.53
440	AF	210	1999	8.48
441	Ln3	0	1999	1.69
442	Ln3	70	1999	6.58
443	Ln3	140	1999	7.58
444	Ln3	210	1999	7.83
445	Ln8	0	1999	3.42
446	Ln8	70	1999	6.59
447	Ln8	140	1999	8.26
448	Ln8	210	1999	6.51
449	Lc3	0	1999	4.42

```
450       Lc3    70 1999  7.27
451       Lc3   140 1999  8.65
452       Lc3   210 1999  9.54
453       Lc8     0 1999  1.79
454       Lc8    70 1999  4.65
455       Lc8   140 1999  5.54
456       Lc8   210 1999  4.95
457        AB     0 2000  1.45
458        AB    70 2000  4.54
459        AB   140 2000  4.52
460        AB   210 2000  5.53
461        AF     0 2000  0.96
462        AF    70 2000  4.87
463        AF   140 2000  6.28
464        AF   210 2000  7.39
465       Ln3     0 2000  3.40
466       Ln3    70 2000  7.06
467       Ln3   140 2000  8.64
468       Ln3   210 2000  8.71
469       Ln8     0 2000  3.42
470       Ln8    70 2000  6.58
471       Ln8   140 2000  7.22
472       Ln8   210 2000  7.49
473       Lc3     0 2000  5.05
474       Lc3    70 2000  8.24
475       Lc3   140 2000  8.96
476       Lc3   210 2000 10.33
477       Lc8     0 2000  4.31
478       Lc8    70 2000  7.47
479       Lc8   140 2000  8.95
480       Lc8   210 2000  9.65
```

```r
# Print the tibble (shows only first 10 rows and column types)
print(wheat_tibble)
```

```
# A tibble: 480 x 4
   rotation nitro  year yield
   <fct>    <int> <int> <dbl>
 1 AB           0  1981  3.84
 2 AB          70  1981  6.59
 3 AB         140  1981  7.49
 4 AB         210  1981  7.39
```

```
 5 AF            0  1981  3.06
 6 AF           70  1981  6.32
 7 AF          140  1981  7.61
 8 AF          210  1981  7.78
 9 Ln3           0  1981  5.82
10 Ln3          70  1981  7.52
# i 470 more rows
```

3 A package for data manipulation…

The `dplyr` package in R provides powerful tools for transforming and analyzing data. In this tutorial, we'll use an agricultural dataset to explore some common `dplyr` functions like `filter()`, `mutate()`, `summarize()`, and `group_by()`.

3.1 Why using R Packages?

- **Efficiency**: Avoid rewriting code for common tasks.
- **Consistency**: Standardized code structure and naming conventions.
- **Reproducibility**: Ensures that your work is easier to share and reproduce.
- **Intuitive**: R packages use functions with intuitive names of functions, so you can spend less time learning the code & more time learning to solve practical problems.

3.2 Example 1: mutate()

Packages like `dplyr` simplify tasks by providing clean, concise code for data manipulation.

1. Create a new column: `total`, which is the sum of two existing columns (`var1` and `var2`).

3.2.0.1 Base R version

```
# Sample data
df <- data.frame(var1 = c(1, 2, 3), var2 = c(4, 5, 6))

# Adding a new column using base R
df$total <- df$var1 + df$var2
```

3.2.0.2 dplyr package (Tidyverse)

```
library(dplyr)

# Using mutate to add a new column
df <- df %>%
  mutate(total = var1 + var2)
```

3.3 Example 2: filter()

2. Filtering: get values of `var1` greater than 2.

3.3.0.1 Base R version

```
# Filter rows using base R
filtered_df <- df[df$var1 > 2, ]
```

3.3.0.2 dplyr package (Tidyverse)

```
# Filter rows using dplyr
filtered_df <- filter(data = df, var1 > 2)
```

3.4 Example 3: select()

3. Select specific variables: get `var1` and `var3`.

3.4.0.1 Base R version

```
# Select columns using base R
selected_df <- df[ , c("var1","var3")]
```

3.4.0.2 dplyr package (Tidyverse)

```
# Filter rows using dplyr
filtered_df <- select(data = df, var1, var3)
```

4 Corn Dataset:

For this tutorial, we'll use the `lasrosas.corn` dataset from the 'agridat' package, which contains information on corn varieties, yields, and topographical features. First, let's load the required packages and inspect the dataset: ## Read data

```
# Load dataset
data("lasrosas.corn") # This creates an object with the name of the dataset "lasrosas.corn"

# Store the data with another name
corn_data <- lasrosas.corn
```

4.1 Inspect data

4.1.1 glimpse

The `glimpse()` function provides an overview of the dataset, including variable names and data types.

```
# Inspect the dataset
glimpse(corn_data)
```

```
Rows: 3,443
Columns: 9
$ year  <int> 1999, 1999, 1999, 1999, 1999, 1999, 1999, 1999, 1999, 1999, 1999~
$ lat   <dbl> -33.05113, -33.05115, -33.05116, -33.05117, -33.05118, -33.05120~
$ long  <dbl> -63.84886, -63.84879, -63.84872, -63.84865, -63.84858, -63.84851~
$ yield <dbl> 72.14, 73.79, 77.25, 76.35, 75.55, 70.24, 76.17, 69.17, 69.77, 6~
$ nitro <dbl> 131.5, 131.5, 131.5, 131.5, 131.5, 131.5, 131.5, 131.5, 131.5, 1~
```

```
$ topo  <fct> W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W, W~
$ bv    <dbl> 162.60, 170.49, 168.39, 176.68, 171.46, 170.56, 172.94, 171.86, ~
$ rep   <fct> R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, R1, ~
$ nf    <fct> N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, N5, ~
```

4.1.2 skim

The `skim()` function from the 'skimr' allows to take a deeper look to all the variables (columns), creating a quick summary that reports the presence of missing values, etc., etc.

```
skimr::skim(corn_data)
```

Table 1: Data summary

Name	corn_data
Number of rows	3443
Number of columns	9
Column type frequency:	
factor	3
numeric	6
Group variables	None

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
topo	0	1	FALSE	4	W: 1043, LO: 885, HT: 785, E: 730
rep	0	1	FALSE	3	R3: 1149, R1: 1147, R2: 1147
nf	0	1	FALSE	6	N1: 577, N3: 575, N5: 575, N0: 573

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
year	0	1	1999.99	1.00	1999.00	1999.00	1999.00	2001.00	2001.00	
lat	0	1	-33.05	0.00	-33.05	-33.05	-33.05	-33.05	-33.05	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
long	0	1	-63.85	0.00	-63.85	-63.85	-63.85	-63.84	-63.84	
yield	0	1	69.83	19.83	12.66	54.54	66.63	84.68	117.90	
nitro	0	1	64.57	42.60	0.00	29.00	66.00	106.00	131.50	
bv	0	1	174.42	9.68	91.74	168.48	173.08	179.39	213.82	

4.2 Adding New Variables with `mutate()`

You can add new columns to your dataset with `mutate()`. Let's calculate the yield in tons per hectare (assuming the current yield is in kilograms):

```r
# Add a column for yield in tons
corn_data <- corn_data %>%
  # New column, `yield_tons`, with the transformed yield values.
  mutate(yield_tons = yield / 1000)

head(corn_data)
```

```
  year       lat      long yield nitro topo     bv rep nf yield_tons
1 1999 -33.05113 -63.84886 72.14 131.5    W 162.60  R1 N5    0.07214
2 1999 -33.05115 -63.84879 73.79 131.5    W 170.49  R1 N5    0.07379
3 1999 -33.05116 -63.84872 77.25 131.5    W 168.39  R1 N5    0.07725
4 1999 -33.05117 -63.84865 76.35 131.5    W 176.68  R1 N5    0.07635
5 1999 -33.05118 -63.84858 75.55 131.5    W 171.46  R1 N5    0.07555
6 1999 -33.05120 -63.84851 70.24 131.5    W 170.56  R1 N5    0.07024
```

4.3 Filtering Data

To focus on specific data, we can use `filter()`. For example, let's filter the data to include only rows where the nitrogen applied (`nitro`) is greater than 100:

```r
# Filter rows with nitro > 100
high_nitro <- corn_data %>%
  # only rows where the `nitro` column has values greater than 100.
  filter(nitro > 100)

head(high_nitro)
```

```
  year       lat      long yield nitro topo     bv rep nf yield_tons
1 1999 -33.05113 -63.84886 72.14 131.5    W 162.60  R1 N5    0.07214
2 1999 -33.05115 -63.84879 73.79 131.5    W 170.49  R1 N5    0.07379
3 1999 -33.05116 -63.84872 77.25 131.5    W 168.39  R1 N5    0.07725
4 1999 -33.05117 -63.84865 76.35 131.5    W 176.68  R1 N5    0.07635
5 1999 -33.05118 -63.84858 75.55 131.5    W 171.46  R1 N5    0.07555
6 1999 -33.05120 -63.84851 70.24 131.5    W 170.56  R1 N5    0.07024
```

4.4 Selecting columns

To select specific variables, we use `select()`, which selects specific columns from the dataset.

```r
# Select specific columns
selected_data <- corn_data %>% select(yield, nitro, topo)
head(selected_data)
```

```
  yield nitro topo
1 72.14 131.5    W
2 73.79 131.5    W
3 77.25 131.5    W
4 76.35 131.5    W
5 75.55 131.5    W
6 70.24 131.5    W
```

4.5 Renaming columns

When we need to change names of columns, we can use `rename()`:

```r
# Rename a column
renamed_data <- corn_data %>% rename(Nitrogen = nitro)
head(renamed_data)
```

```
  year       lat      long yield Nitrogen topo     bv rep nf yield_tons
1 1999 -33.05113 -63.84886 72.14    131.5    W 162.60  R1 N5    0.07214
2 1999 -33.05115 -63.84879 73.79    131.5    W 170.49  R1 N5    0.07379
3 1999 -33.05116 -63.84872 77.25    131.5    W 168.39  R1 N5    0.07725
4 1999 -33.05117 -63.84865 76.35    131.5    W 176.68  R1 N5    0.07635
5 1999 -33.05118 -63.84858 75.55    131.5    W 171.46  R1 N5    0.07555
6 1999 -33.05120 -63.84851 70.24    131.5    W 170.56  R1 N5    0.07024
```

4.6 Arranging data

To reorder the data based on specific criteria, we can use `arrange()`, which will arrange rows by a variable in ascending or descending order.

```
# Arrange data by yield in descending order
arranged_data <- corn_data %>% arrange(desc(yield))
head(arranged_data)
```

```
  year       lat      long  yield nitro topo     bv rep nf yield_tons
1 2001 -33.05086 -63.84317 117.90  99.8   LO 162.17  R3 N4    0.11790
2 2001 -33.05125 -63.84245 117.19 124.6   LO 165.81  R3 N5    0.11719
3 2001 -33.05181 -63.84323 116.64 124.6   LO 159.75  R1 N5    0.11664
4 2001 -33.05084 -63.84324 114.94  99.8   LO 166.27  R3 N4    0.11494
5 2001 -33.05134 -63.84299 114.46  99.8   LO 164.58  R2 N4    0.11446
6 2001 -33.05127 -63.84238 114.08 124.6   LO 170.94  R3 N5    0.11408
```

4.7 Finding unique values

To find out what are the unique values of a variable, we can use `distinct()`, which will return the unique values within a column.

```
# Unique values in topo
unique_topo <- corn_data %>% distinct(topo)
unique_topo
```

```
  topo
1    W
2   HT
3    E
4   LO
```

4.8 Counting

The function `count()` counts the number of observations within a group.

```
# Count observations by topo
topo_count <- corn_data %>% count(topo)
topo_count
```

```
  topo    n
1    E  730
2   HT  785
3   LO  885
4    W 1043
```

4.9 Summarizing Data

To get a quick overview of your data, you can use `summarize()` in combination with `group_by()`. For example, let's calculate the average yield for each topographical category (`topo`):

```r
# Average yield by topography
average_yield_topo <- corn_data %>%
  group_by(topo) %>%
  summarize(avg_yield = mean(yield, na.rm = TRUE))
average_yield_topo
```

```
# A tibble: 4 x 2
  topo  avg_yield
  <fct>     <dbl>
1 E          78.7
2 HT         48.6
3 LO         84.9
4 W          66.8
```

```r
# Average yield by year and topography
average_yield_topoyear <- corn_data %>%
  group_by(year, topo) %>%
  summarize(avg_yield = mean(yield, na.rm = TRUE))
```

```
`summarise()` has grouped output by 'year'. You can override using the
`.groups` argument.
```

```r
average_yield_topoyear
```

```
# A tibble: 8 x 3
# Groups:   year [2]
   year topo  avg_yield
  <int> <fct>     <dbl>
```

```
1  1999 E           64.8
2  1999 HT          53.4
3  1999 LO          71.2
4  1999 W           66.0
5  2001 E           92.7
6  2001 HT          44.7
7  2001 LO          99.9
8  2001 W           67.7
```

This groups the data by `topo` and calculates the mean yield for each group.

5 Hands-On Exercise

Try the following tasks using the `lasrosas.corn` dataset:

1. Filter the data to include only rows where the yield is greater than 6000.
2. Add a new column that calculates yield per kilogram of nitrogen applied.
3. Summarize the data to find the total yield for each `topo` category.
4. Arrange the data by `nitro` in ascending order.
5. Use `select()` to create a dataset with only the `yield`, `topo`, and `nitro` columns.

Submit your code and results to the class discussion forum. Happy coding!

6 Conclusion

The `dplyr` package simplifies data transformation and analysis tasks, making it easier to work with agricultural datasets like the one in this tutorial. Use these functions and try the hands-on exercise to deepen your understanding.

Happy coding!

Wickham, Hadley. 2014. "Tidy Data." *Journal of Statistical Software* 59 (10). https://doi.org/10.18637/jss.v059.i10.

Wickham, Hadley, and Garrett Grolemund. 2017. *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. 1st ed. Paperback; O'Reilly Media. http://r4ds.had.co.nz/.