

## Tabular Display of Data

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*Getting information from a table is like extracting sunlight from a cucumber.*

*Farquhar and Farquhar, 1891, p55*

Perhaps not that bad, but a challenge.

Our examples from Ehrenberg (1977, **JRSSA**) and Wainer (1997, **JEBS**).

## Eye on the ball

Most displays only do one thing well.

*To build any effective display we must have a firm notion of purpose. We cannot know what the best answers are unless we know what the questions are. Thus we must first understand what questions will be asked of data. Any discussion of data display in the abstract is pointless.*

*Wainer (1997 **JEBS**)*

We will concentrate on communication.

## Back to communication

A display for communication should

- Target an audience
- Have a goal (tell a story)
- Make the story obvious
- Be uncluttered
- Cause no pain

It's a lot like oral communication!

## Rules for Communication

Ehrenberg, Wainer, and many others give rules/advice.

We illustrate with examples from their papers.

Remember, we want to communicate, to show a story, which could be

- Big picture
- Trends
- Comparisons
- Typical values
- Atypical values

## Ehrenberg's Criteria

### Strong Criterion for Good Table

The patterns and exceptions in a table should be obvious at a glance.

### Weak Criterion for Good Table

The patterns and exceptions in a table should be obvious at a glance once one has been told what they are.

Always meet the weak criterion.

## UK Vessels (Ehrenberg, 1977)

UK Merchant Vessels over 500 tons in Service

	1962	1967	1973
Number of vessels			
All vessels	2,689	2,181	1,776
Passenger	242	173	122
Dry cargo	1,847	1,527	1,165
Tankers	600	481	489
Deadweight in thousands of tons			
All vessels	26,577	27,488	46,763
Passenger	1,467	919	349
Dry cargo	13,990	14,362	20,115
Tankers	11,120	12,167	26,299

## UK Vessels – After

UK Merchant Vessels in Service

Vessels over 500 tons	1962	1967	1973
Number			
Passenger	240	170	120
Tankers	600	480	490
Dry cargo	1,800	1,500	1,200
All vessels	2,700	2,200	1,800
Deadweight tons (thousands)			
Passenger	1,500	920	350
Tankers	11,000	12,000	26,000
Dry cargo	14,000	14,000	20,000
All vessels	26,000	27,000	47,000

## TV Correlations (Ehrenberg)

Correlation among TV audiences

		PrB	ThW	Tod	WoS	GrS	LnU	MoD	Pan	RgS	24H
ITV	PrB	1.000	0.106	0.065	0.505	0.474	0.092	0.473	0.168	0.309	0.124
"	ThW	0.106	1.000	0.270	0.142	0.132	0.189	0.082	0.352	0.064	0.395
"	Tod	0.065	0.270	1.000	0.093	0.070	0.155	0.038	0.200	0.051	0.244
"	WoS	0.505	0.147	0.093	1.000	0.622	0.079	0.581	0.187	0.297	0.140
BBC	GrS	0.474	0.132	0.070	0.622	1.000	0.085	0.593	0.181	0.341	0.142
"	LnU	0.092	0.189	0.155	0.079	0.085	1.000	0.049	0.197	0.097	0.266
"	MoD	0.473	0.082	0.039	0.581	0.593	0.049	1.000	0.131	0.327	0.122
"	Pan	0.168	0.352	0.200	0.187	0.181	0.197	0.131	1.000	0.147	0.524
"	RgS	0.309	0.064	0.051	0.296	0.341	0.097	0.326	0.147	1.000	0.121
"	24H	0.124	0.395	0.244	0.140	0.142	0.266	0.122	0.524	0.121	1.000

## TV Correlations – After

Correlation among TV audiences

Programmes		WoS	MoD	GrS	PrB	RgS	24H	Pan	ThW	Tod	LnU
World of Sport	ITV	.6	.6	.5	.3	.1	.2	.1	.1	.1	.1
Match of the Day	BBC	.6	.6	.5	.3	.1	.1	.1	.1	.0	.0
Grandstand	BBC	.6	.6	.5	.3	.1	.2	.1	.1	.1	.1
Prof. Boxing	ITV	.5	.5	.5	.3	.1	.2	.1	.1	.1	.1
Rugby Special	BBC	.3	.3	.3	.3	.1	.1	.1	.1	.1	.1
24 Hours	BBC	.1	.1	.1	.1	.1	.5	.4	.2	.2	.2
Panorama	BBC	.2	.1	.2	.2	.1	.5	.4	.2	.2	.2
This Week	ITV	.1	.1	.1	.1	.1	.4	.4	.3	.2	.2
Today	ITV	.1	.0	.1	.1	.1	.2	.2	.3	.2	.2
Line Up	BBC	.1	.0	.1	.1	.1	.2	.2	.2	.2	.2

## Unemployment (Ehrenberg)

Unemployment in Great Britain (thousands)

	1966	1968	1970	1973
Total unemployed	330.9	549.4	582.2	597.9
Males	259.6	460.7	495.3	499.4
Females	71.3	88.8	86.9	98.5

## Unemployment – After Rounding

Unemployment in Great Britain (thousands)

	1966	1968	1970	1973
Total unemployed	330	550	580	600
Males	260	460	500	500
Females	71	89	87	98

## Unemployment – After Summary

Unemployment in Great Britain (thousands)

	1966	1968	1970	1973	Ave.
Total unemployed	330	550	580	600	520
Males	260	460	500	500	430
Females	71	89	87	98	86

## Unemployment – After Transposition

Unemployment in Great Britain (thousands)

Year	Male	Female	Total
1966	260	71	330
1968	460	89	550
1970	500	87	580
1973	500	99	600
Average	430	86	520

## Battery Life (Wainer)

Battery Life in Hours

Battery Brand	Cassette Player	Radio	Flashlight	Portable Computer
Constant Charge	5	19	10	3
Electro-Blaster	10	26	15	4
Never Die	8	28	16	6
PowerBat	7	24	13	5
Servo-Cell	4	21	12	2

## Battery Life – After Ordering

Battery Life in Hours

Battery Brand	Radio	Flashlight	Cassette Player	Portable Computer
Never Die	28	16	8	6
Electro-Blaster	26	15	10	4
PowerBat	24	13	7	5
Servo-Cell	21	12	4	2
Constant Charge	19	10	5	3

## Battery Life – After Summaries

Battery Brand	Battery Life in Hours				Brand Averages
	Radio	Flash.	Cass. Player	Port. Comp.	
Never Die	28	16	8	6	15
Electro-Blaster	26	15	10	4	14
PowerBat	24	13	7	5	12
Servo-Cell	21	12	4	2	10
Constant Charge	19	10	5	3	9
<b>Usage averages</b>	<b>24</b>	<b>13</b>	<b>7</b>	<b>4</b>	<b>12</b>

## Battery Life – After Spacing

Battery Brand	Battery Life in Hours				Brand Averages
	Radio	Flash.	Cass. Player	Port. Comp.	
Never Die	28	16	8	6	15
Electro-Blaster	26	15	10	4	14
PowerBat	24	13	7	5	12
Servo-Cell	21	12	4	2	10
Constant Charge	19	10	5	3	9
<b>Usage averages</b>	<b>24</b>	<b>13</b>	<b>7</b>	<b>4</b>	<b>12</b>

## Multivariate (Wainer, 1997)

PUBLIC SCHOOLS	Grade 8 - 1992									
	Graduated College		Some Education After High School		Graduated High School		Did Not Finish High School		I Don't Know	
	Percentage of Students	Average Proficiency	Percentage of Students	Average Proficiency	Percentage of Students	Average Proficiency	Percentage of Students	Average Proficiency	Percentage of Students	Average Proficiency
<b>NATION</b>	40 (1.4)	279 (1.4)	18 (0.8)	270 (1.2)	25 (0.8)	256 (1.4)	8 (0.6)	248 (1.8)	9 (0.5)	251 (1.7)
Northeast	38 (3.1)	282 (4.2)	18 (1.1)	267 (3.0)	26 (2.2)	259 (4.2)	8 (0.9)	248 (4.3)	10 (1.2)	250 (3.3)
Southeast	35 (1.8)	270 (1.9)	17 (0.8)	263 (2.0)	28 (1.4)	248 (1.9)	12 (1.8)	246 (4.2)	8 (1.0)	248 (4.3)
Central	42 (2.7)	283 (2.9)	20 (1.4)	273 (1.6)	26 (1.7)	264 (2.3)	4 (0.7)	244 (1.7)	7 (0.8)	258 (3.8)
West	43 (2.9)	279 (2.6)	18 (1.2)	274 (2.6)	19 (1.5)	252 (2.9)	9 (1.1)	246 (2.4)	11 (0.9)	248 (2.9)
<b>STATES</b>										
Alabama	33 (1.8)	261 (2.5)	18 (0.7)	258 (2.0)	29 (1.1)	244 (1.8)	13 (0.9)	238 (2.0)	7 (0.8)	237 (2.9)
Arizona	36 (1.5)	271 (1.5)	22 (1.0)	270 (1.5)	21 (0.9)	256 (1.8)	10 (0.7)	245 (2.5)	12 (0.8)	248 (2.7)
Arkansas	30 (1.1)	264 (1.9)	20 (0.8)	264 (1.7)	31 (1.1)	248 (1.6)	11 (0.7)	246 (2.4)	8 (0.8)	245 (2.7)
California	39 (1.8)	275 (2.0)	18 (1.0)	268 (2.1)	17 (0.9)	251 (2.1)	10 (0.9)	241 (2.2)	16 (1.1)	240 (2.9)
Colorado	46 (1.2)	282 (1.3)	19 (0.9)	278 (1.6)	21 (0.9)	260 (1.5)>	6 (0.6)	250 (2.4)	7 (0.5)	252 (2.6)
Connecticut	47 (1.3)	288 (1.0)>	16 (0.8)	272 (1.8)	22 (0.9)	260 (1.8)	6 (0.6)	245 (3.3)	9 (0.6)	251 (2.4)
Delaware	39 (1.2)	274 (1.3)	18 (1.0)	268 (2.3)	30 (1.0)	251 (1.7)	6 (0.5)	248 (4.0)	8 (0.9)	248 (3.4)
Dist. Columbia	32 (1.0)	244 (1.7)	17 (0.8)	240 (1.9)	29 (0.8)	224 (1.6)	9 (0.7)	225 (3.2)	12 (0.8)	229 (2.2)
Florida	39 (1.5)	268 (1.9)	19 (0.7)	266 (1.9)	24 (1.1)	251 (1.8)	8 (0.7)	244 (2.7)	10 (0.7)	244 (3.2)
Georgia	35 (1.7)	271 (2.1)	18 (0.7)	264 (1.7)	30 (1.2)	250 (1.3)	11 (0.8)	244 (2.2)	8 (0.6)	245 (2.6)
Hawaii	36 (1.5)	267 (1.5)	15 (0.8)<	266 (1.8)	23 (1.0)	246 (1.8)	6 (0.5)	242 (3.5)	16 (0.8)	246 (1.1)
Idaho	48 (1.2)	281 (0.9)	20 (0.8)	278 (1.3)	19 (0.9)	288 (1.4)>	7 (0.5)	254 (2.3)	6 (0.5)	254 (2.8)
Indiana	33 (1.5)	283 (1.5)	21 (0.9)	275 (1.9)	32 (1.1)	260 (1.6)	8 (0.6)	250 (2.6)	6 (0.5)	249 (3.3)
Iowa	44 (1.4)	291 (1.2)>	21 (0.8)	285 (1.5)	25 (1.1)	273 (1.3)	4 (0.4)	262 (2.4)	5 (0.4)	266 (2.8)
Kentucky	28 (1.4)	278 (1.6)>	19 (0.8)	267 (1.6)	32 (0.9)	254 (1.6)	15 (0.9)	246 (1.7)	6 (0.4)	242 (2.8)
Louisiana	32 (1.4)	256 (2.5)	20 (0.9)	259 (1.8)	30 (1.3)	242 (1.8)	10 (0.7)	237 (2.4)	7 (0.6)	236 (3.7)
Maine	40 (1.5)	288 (1.4)	22 (1.0)	281 (1.5)	28 (1.1)	267 (1.1)	6 (0.5)	259 (2.1)	6 (0.5)	266 (2.6)
Maryland	44 (1.7)	278 (1.8)	18 (0.9)	268 (1.9)	25 (1.2)	250 (1.8)	6 (0.8)	240 (3.7)	7 (0.5)	245 (3.8)
Massachusetts	48 (1.5)	284 (1.3)	17 (0.8)	272 (1.8)	21 (1.0)	261 (1.4)	7 (0.6)	248 (3.2)	7 (0.6)	248 (2.6)
Michigan	36 (1.6)	277 (2.2)	23 (0.9)	271 (2.0)	26 (0.9)	257 (1.7)	6 (0.5)	249 (2.5)	7 (0.6)	248 (3.0)
Minnesota	48 (1.3)>	290 (1.0)>	21 (0.9)	284 (1.8)	22 (0.9)<	270 (1.8)>	3 (0.4)	256 (4.2)	7 (0.8)	268 (3.0)
Mississippi	36 (1.3)	254 (1.6)	18 (0.7)	256 (2.0)	28 (1.4)	239 (1.6)	13 (0.8)	234 (1.8)	7 (0.5)	231 (2.8)
Missouri	36 (1.3)	280 (1.7)	22 (0.9)	275 (1.5)	29 (1.0)	264 (1.8)	8 (0.7)	254 (2.4)	6 (0.5)	252 (2.9)
Nebraska	46 (1.5)	287 (1.2)	20 (1.0)	280 (1.6)	24 (1.2)	267 (1.7)	4 (0.5)	247 (3.3)	6 (0.6)	256 (3.8)

Hard to see anything!  
But perhaps useful for archival purposes.

## Foods (Ehrenberg, 1978)

Consumers' (C) and Retailers' (R) ratings of the nutritional and economic values of different foods

Foods	Nutritional		Economic	
	C	R	C	R
Meat	62	58	14	11
Milk	55	52	44	95
Eggs	49	48	85	61
Cheese	45	52	30	62
Fresh Veg.	42	24	25	18
Fish	33	52	20	10
Chicken	18	13	70	25
Bread	5	11	5	21

\*In decreasing order of Consumers' Nutritional Ratings.

... hard to interpret without a *verbal description*  
perhaps "Consumers and retailers agree quite well on nutritional ratings, but economic ratings differ from each other and from the nutritional ones."

## Computer files

Computer files also need explanation.

```
# Number of hawks responding to the "alarm" call
# Variables are year (1999 or 2000), season (courtship,
# nestling, fledgling), distance in meters between the
# alarm call and the nest, number of hawks responding,
# and number of.
```

year	season	distance	respond	trials
1	1	100	1	4
1	1	150	2	4
1	1	225	1	4
1	1	325	2	2
2	1	100	6	8

...

Should be labeled and annotated.

## Exceptions

Point out unusual values

PUBLIC SCHOOLS	Nation	Some Education				Mean	
		Graduated College	After High School	Graduated High School	Did Not Finish High School		
	Nation	279	270	256	248	251	267
	States						
1	Iowa	291	285	273	262	266	283
2	North Dakota	289	283	271	259	272	283
3	Minnesota	290	284	270	256	268	282
4	Maine	288	281	267	259	266	278
5	Wisconsin	287	282	270	254	255	278
6	New Hampshire	287	280	267	259	262	278
7	Nebraska	287	280	267	247	256	277
8	Idaho	281	278	268	254	254	274
9	Wyoming	281	278	266	258	260	274
10	Utah	280	278	258	254	258	274
11	Connecticut	288	272	260	245	251	273

## Round Drastically

Use two significant figures where ever possible.

- Don't usually understand more than two digits  
Budget is \$27,329,681 versus budget is 27 million dollars.
- Rarely justify more than two digits statistically  
God gave us  $1/\sqrt{n}$ , but how big must  $n$  be for that third digit?
- We rarely care  
Life expectancy 67.14 years; .01 year is about 4 days.
- Not for archival tables.

## Order Rows/Columns Sensibly

Helps organize and facilitate comparison

- Alphabetical (Alabama first!) almost never correct
- Could be by size
- Could be a natural order, such as time
- By interest (rows or columns to compare should be adjacent)

## Row/Column Summaries

Give a standard for comparison

- Could be mean/median/total/etc
- Give a visual focus
- Provide a standard of “usual”
- An overall summary can also help
- Can highlight for emphasis

## Transpose

It's easier to compare numbers down columns.

- Numbers are closer
- Digits line up

## Layout/Spacing

- Remove excess lines/boxing
- Use space to emphasize groups/gaps
- Excess space breaks adjacency

What is a stem and leaf plot, but a severely rounded table with meaningful spacing?

## Avoid if you can

- Multidimensional tables
- Multivariate tables
- Too many rows or columns

## Add

- Labels
- Good titles and explanatory text

The table with its labels, title, and accompanying text should stand alone and be comprehensible.

Also add emphasis to unusual values.

## Summary

- Design for purpose and audience
- Round!
- Organize
- Simplify
- Add summaries
- Good title/labels
- Clean layout/proper spacing