
Thinking
About
Processes

Why we leapt

- SPSS costs over $2K/year if you want to do GLM.
- Most of our evaluation projects are computer science education projects.
- Data visualization options
- Ease of combining datasets, adding new data
- Replicability
- Future-proofing - reporting will increasingly use packages combining word processing and analysis
- I just wanted to

IBM SPSS Statistics — Base Subscription

1 authorized user

Billing term: Up Front
Subscription Term: 12 months auto-renewal
$1,188.00 USD

Add-ons: 1

— Details
Custom Tables & Advanced Statistics Users
+$948.00 USD

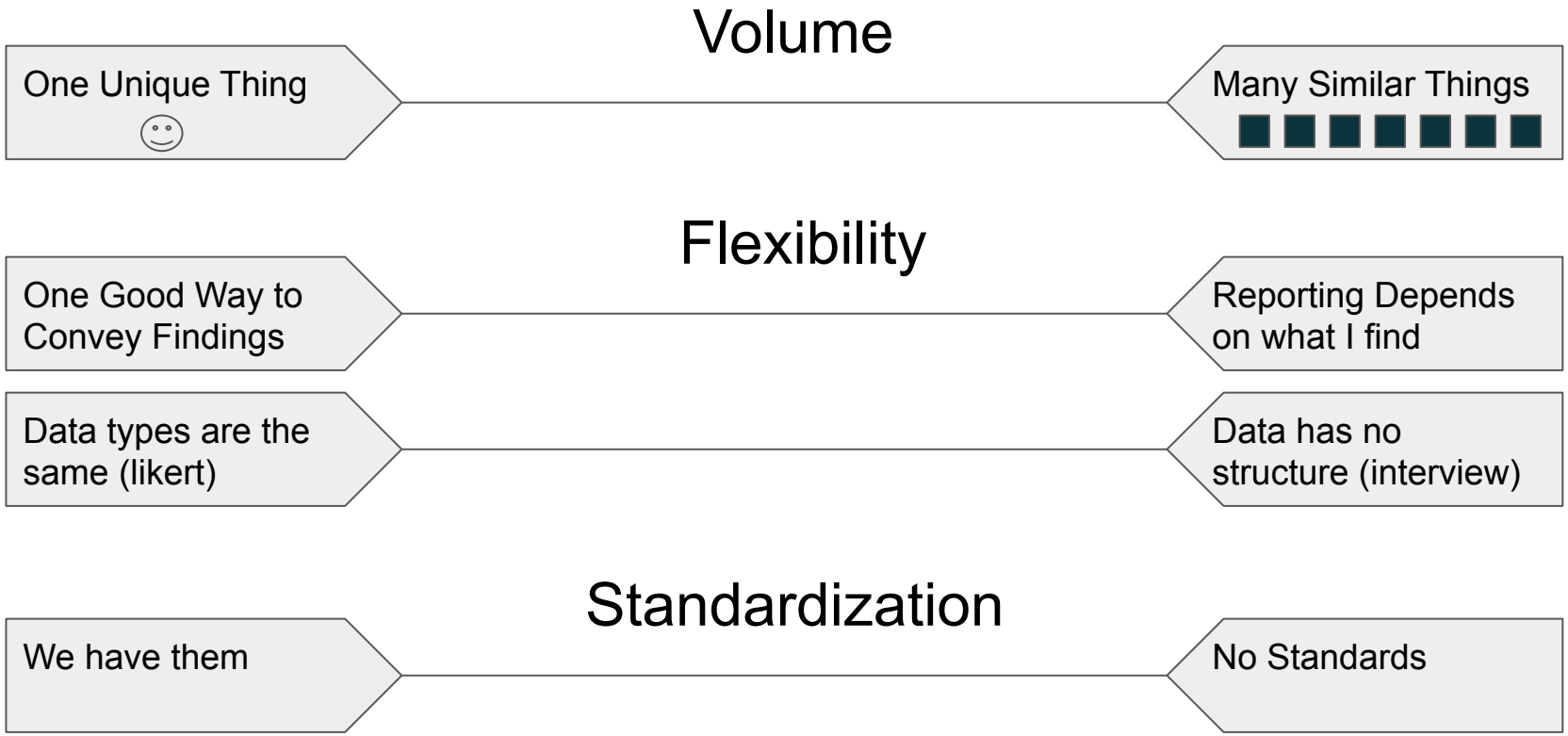
Price: **$2,136.00 USD**

Prices shown excludes any applicable taxes.

Continue to checkout

Want SEM? That's $8,540/yr

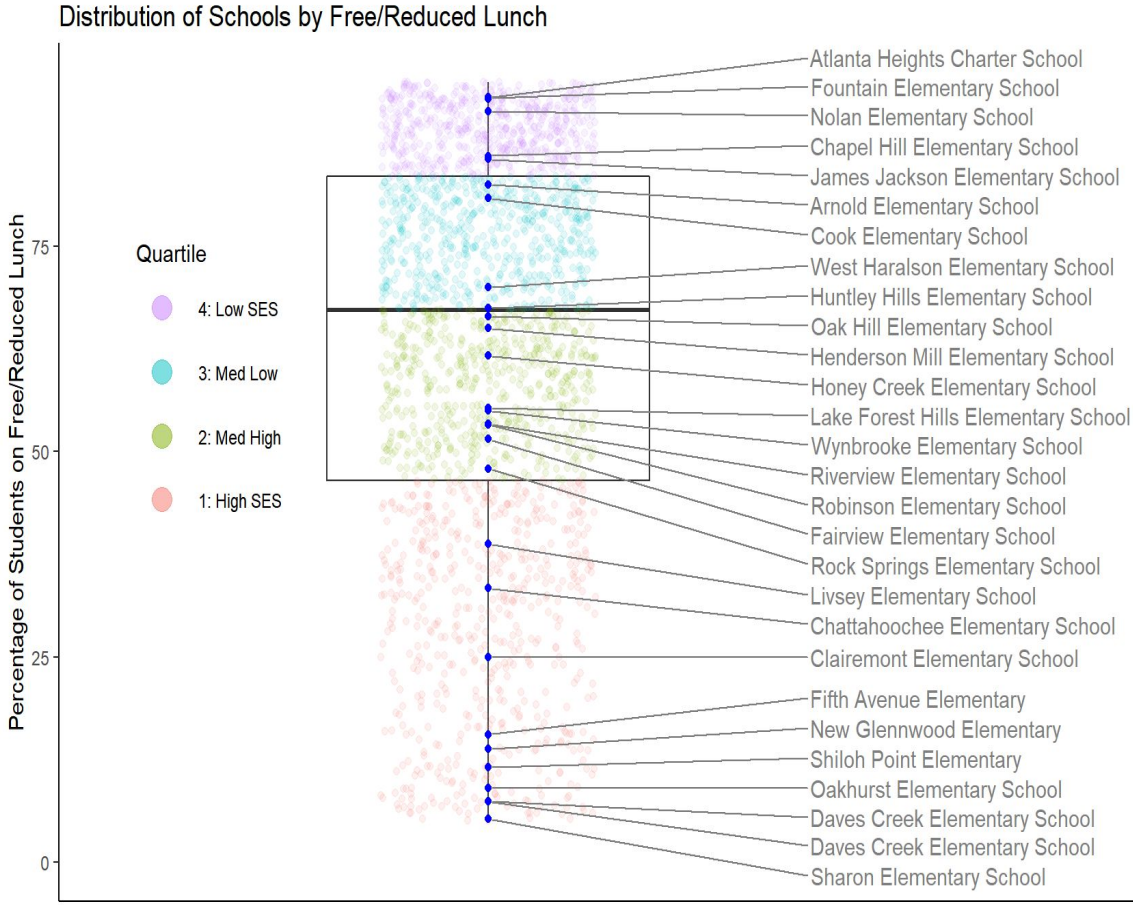
How Does Your Organization Spend Its Time?



How My Company Spends Its Time

Planning, Collection, & Analysis/Reporting. Within the later we build:

1. Frequency tables of Likert scale data
2. Knowledge assessments showing number of items correct and average score
3. Unique visualizations:
   a. Map of locations (e.g. all high schools teaching AP CS)
   b. Client's project in context
4. Synthesis of open-ended responses



Reporting Frequencies: Now

Table 3. Students' Growth in Attitudes Towards Science (n = 81)

Item	Pre/Post	Mean	Difference	p value	Cohen's d	No Way!!!	No	Maybe	Yes	Lots!!!
I am good at science.	Pre	3.75	0.26	.089	0.28	3%	11%	23%	37%	27%
	Post	4.01				1%	4%	19%	45%	31%
I like science.	Pre	4.07	0.06	.681	0.06	3%	3%	19%	37%	39%
	Post	4.13				4%	5%	12%	34%	46%
I would like to be a scientist	Pre	2.79	0.28	.135	0.24	13%	24%	45%	5%	12%
	Post	3.07				12%	20%	34%	16%	18%
Scientists are cool.	Pre	4.15	0.14	.340	0.15	1%	3%	20%	32%	44%
	Post	4.29				4%	1%	12%	28%	55%

Note: The sample size n in this table is the number of total participations of BioBus. In the figure, * indicates significance at $p < .05$; ** indicates significance at $p < .01$, and *** indicates significance at $p < .001$. Cohen's d is an effect size where <= 0.20 is considered small, <= 0.80 is considered medium, and > 0.80 is considered large.

Types of Processes

Project:

- High flexibility
- Unique products (houses, skyscrapers, bridges)
- R: detailed figure overlaying multiple data points; shiny app

Types of Processes

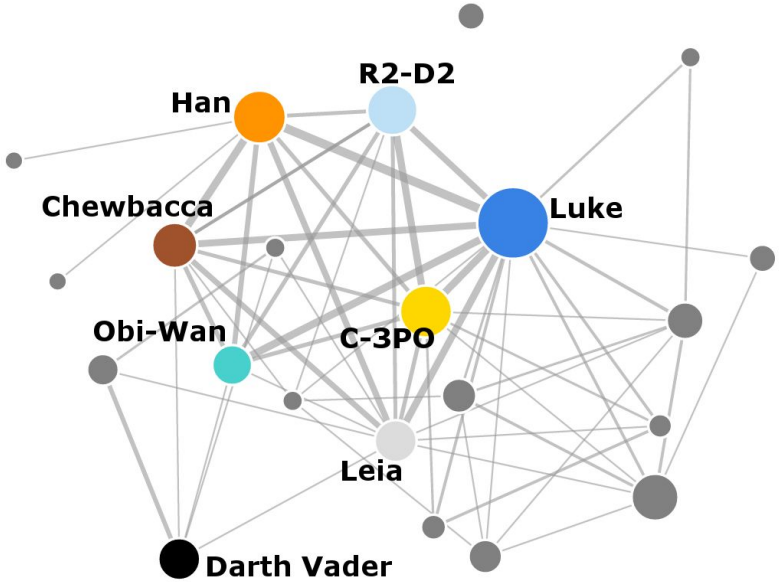
Job Shop:

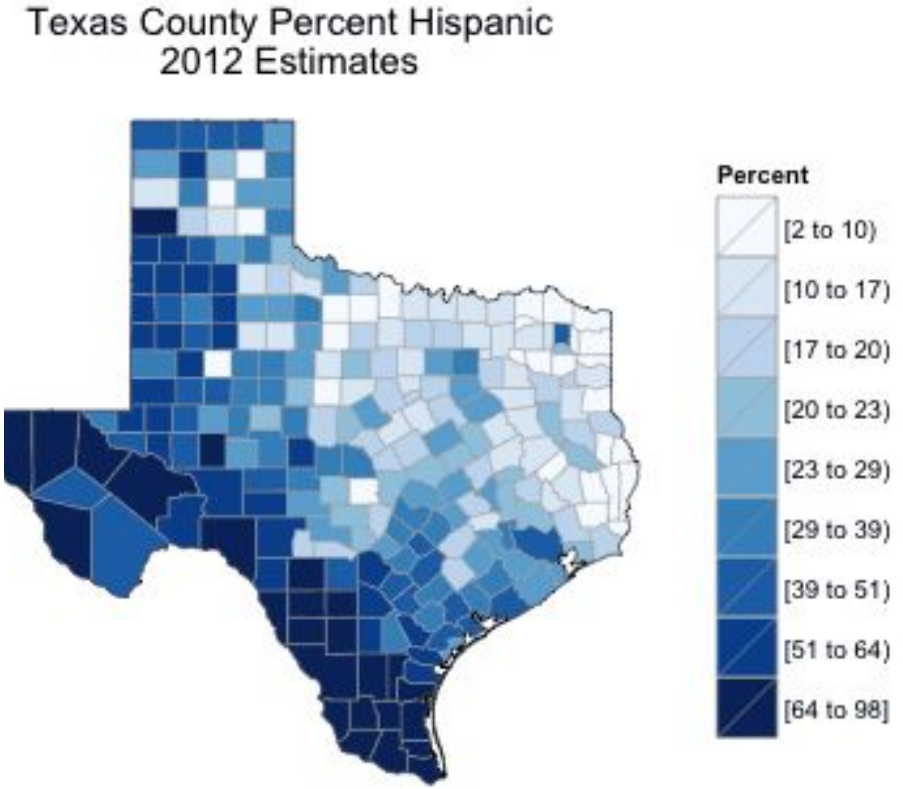
- Low volume
- Irregular demand
- Long periods between orders like print shops and tailoring

Job Shop

Visualizing Data

- GIS Mapping
- Sociograms





Types of Processes

Batch:

- Multiple products
- Small to moderate volumes
- Some flexibility from batch to batch like bakeries

Table 1. Content Knowledge Assessment Results (n = 15)

Item	Average % Correct	Difficulty	*Computer Science Principles Essential Knowledge*	Item Response
Item 1	67%	Moderate	5.3.1I	Incorrect
Item 2	87%	Easy	5.3.1J	Correct
Item 3	100%	Easy	5.3.1K	Correct
Item 4	53%	Moderate	5.5.1 E, 5.5.1 F	Correct
Item 5	87%	Easy	5.5.1D, 5.5.1E, 5.5.1G	Correct
Item 6	67%	Moderate	5.5.1D, 5.5.1E, 5.5.1G	Correct
Item 7	40%	Hard	5.5.1A, 5.5.1D	Incorrect
Item 8	73%	Moderate	5.2.1B, 5.2.1C, 5.5.1A, 5.5.1D	Correct
Item 9	73%	Moderate	5.5.1D, 5.4.1D	Correct
Item 10	33%	Hard	5.2.1A, 5.2.1B, 5.3.1C, 5.3.1D, 5.3.1G, 5.3.1K, 5.5.1E, 5.5.1F, 5.5.1J	Incorrect
Item 11	73%	Moderate	5.1.2A, 5.4.1D, 5.4.1E, 5.4.1F, 5.4.1H, 5.4.1L	Incorrect
Item 12	93%	Easy	5.3.1A, 5.3.1B, 5.3.1D	Correct
Item 13	67%	Moderate	5.5.1A, 5.5.1D , 5.2.1.J, 5.3.1K, 5.5.1H, 5.5.1J	Correct
Item 14	93%	Easy	5.5.1D, 5.5.1E, 5.5.1F, 5.5.1G	Correct
Item 15	80%	Moderate	5.2.1B, 5.2.1C, 5.2.1D, 5.2.1E, 5.5.1D, 5.5.1H, 5.5.1J	Correct
Item 16	73%	Moderate	5.2.1B, 5.2.1C, 5.2.1D, 5.2.1E, 5.4.1F, 5.4.1G, 5.4.1L, 5.5.1D	Correct
Item 17	60%	Moderate	5.3.1H, 5.3.1E, 5.3.1M, 5.3.1O	Incorrect
Item 18	53%	Moderate	5.2.1B, 5.3.1K, 5.3.1L, 5.5.1H, 5.5.1I, 5.5.1J	Incorrect
Item 19	53%	Moderate	5.2.1E, 5.3.1K, 5.4.1F, 5.4.1N, 5.5.1D, 5.5.1H	Incorrect
Item 20	87%	Easy	5.1.2G, 5.1.2H	Correct

Batch:

R: Same report to multiple sites/ participants (Knowledge assessment report)

Types of Processes

Line:

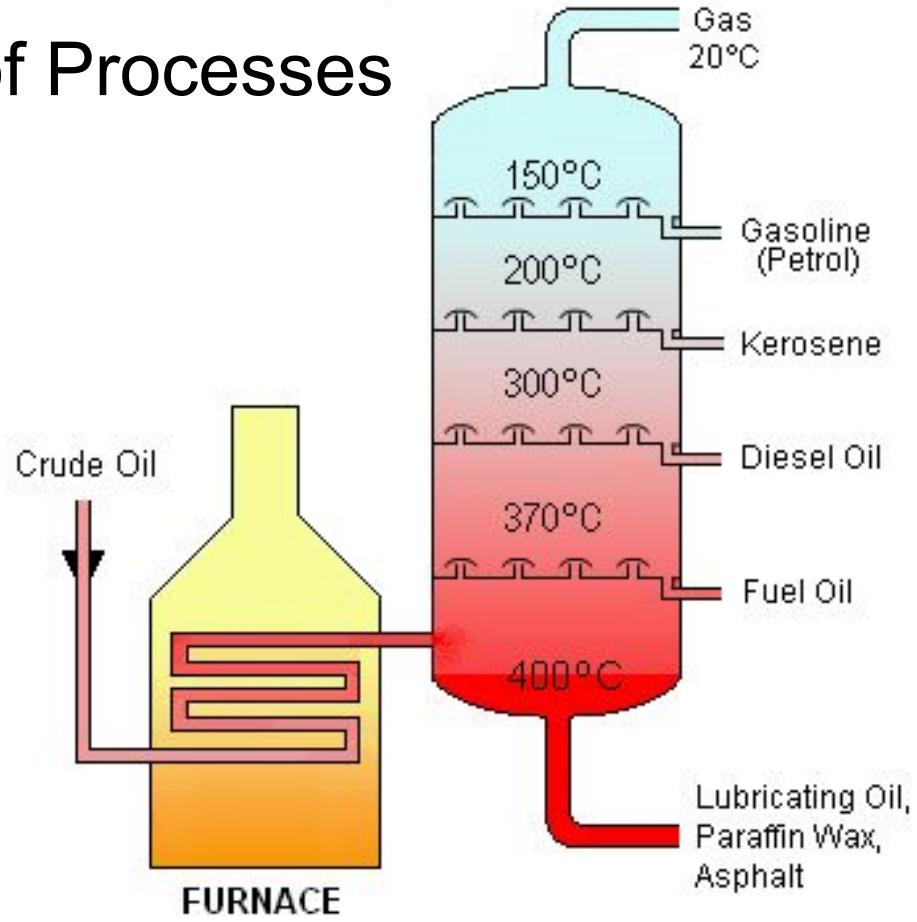
- Low flexibility
- Few products
- High volume like automobile manufacturing

R Supports Batch/Line Work

Frequency Tables from Likert Scale Data

- Inputs: raw data, constructs and items identified, acceptable response options, response options that represent missing data
- R:
  - Provides data summary (not for the report, but for evaluator to double-check the data)
  - Builds frequency table for each construct
  - Builds frequency table comparing constructs
  - Checks for and compares pre/post
  - Runs factor analysis on each construct
  - Inserts sparklines for each item

Types of Processes



Continuous Flow:

- Fixed pace and sequence
- Few products at very high volumes such as oil refineries.
- R: Analyzing google searches or twitter messages

http://bit.ly/benefitsofR

Thinking About Processes

Where Does R Fit In?

1. Frequency tables of Likert scale data
2. Knowledge assessments showing number of items correct and average score
3. Unique visualizations:
   a. Map of locations (e.g. all high schools teaching AP CS)
   b. Client's project in context
4. Synthesis of open-ended responses

R is great at doing the same task lots of times (Assembly Line)

R is also great at visualizing data primarily through overlays (Project or Job Shop)

Can R really help with this? Sentiment analysis?

Agenda

1. Why we leapt
2. Reporting Then & Now
3. Let’s Think About Our Processes
4. Reflecting on the Decision

Reporting Frequencies: Before

Table 3. Self-Regulation/Self-Motivation

Self-Regulation/Self-Motivation		n	Mean[1]	Paired Samples t-test[2]	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
10. I turn all my assignments in on time.	Before	304	3.52	p<0.001**	1%	9%	45%	28%	17%
	Now	302	3.74		2%	5%	34%	34%	25%
11. I miss class often. (n)	Before	300	1.61	p=0.474	66%	16%	11%	4%	3%
	Now	301	1.63		69%	12%	9%	7%	3%
12. I am often late for class. (n)	Before	299	1.92	p=0.524	49%	25%	16%	6%	4%
	Now	298	1.96		50%	21%	15%	8%	5%
13. I set aside time to do my homework and study.	Before	301	3.43	p<0.001**	5%	7%	45%	28%	15%
	Now	299	3.72		3%	5%	36%	31%	25%
14. When I say I'm going to do something, I do it.	Before	303	3.54	p<0.001**	2%	8%	42%	32%	17%
	Now	302	3.84		1%	2%	33%	38%	25%
15. I am a hard worker.	Before	303	3.89	p<0.001**	1%	3%	31%	35%	30%
	Now	302	4.12		1%	2%	19%	38%	39%
16. I finish whatever I	Before	301	3.61	p<0.001**	2%	5%	41%	32%	19%

Your Turn

What does your work really look like?

- Project
- Job Shop
- Batch
- Assembly Line
- Continuous Flow

Reflecting on the Leap

1. Learning R:
   a. dplyr verbs
   b. Data types: why does it think my
   c. pairing research assistant with an a
   d. Coding together
   e. Flexible expectations: delivering reports as HT
2. What went wrong
   a. Handling missing data
   b. Lost sparklines
3. What went right
   a. Replicating 30 reports
   b. Showing the work

Remove row 5 but keep the other rows:

drop_na
drop_na_
na.omit
na.exclude
complete.cases
filter(!is.na())
janitor::remove_empty("rows")

	year	q1	q2	q3
1	2001	1	2	*NA*
2	2001	2	3	1
3	2002	3	*NA*	2
4	2003	4	4	3
5	*NA*	*NA*	*NA*	*NA*

Shifting an Organization to R

Increase in CS

X of Y middle school participants all had experience coding

AP CSP and AP CS A experiencing a growth from x to y

We are slowly moving into a space in which people understand algorithms

Our reporting is shifting

Once we incorporated tables and figures into MS Word documents. Required building out the figures in Excel or SPSS, doing calculations in Excel or SPSS, formatting tables in MS Word. If we did GIS, we used a separate tool (maybe ARC GIS).

Clients received a pdf based on a Word doc. We didn't have to justify the analysis - didn't have to reveal the decisions about data cleaning, didn't have to reveal the parameters of statistical tests, didn't reveal the data, didn't offer more than cursory strategies for replication.

Scrutiny of peers invites good work.

Timeline of Reporting

Day 1: Design survey instrument

Day 8: Render on paper or survey software

Day10: Administer

Wait (maybe 3 weeks)

Day 31: Close survey

Day 31: Download and analyze

Day 38: Share report

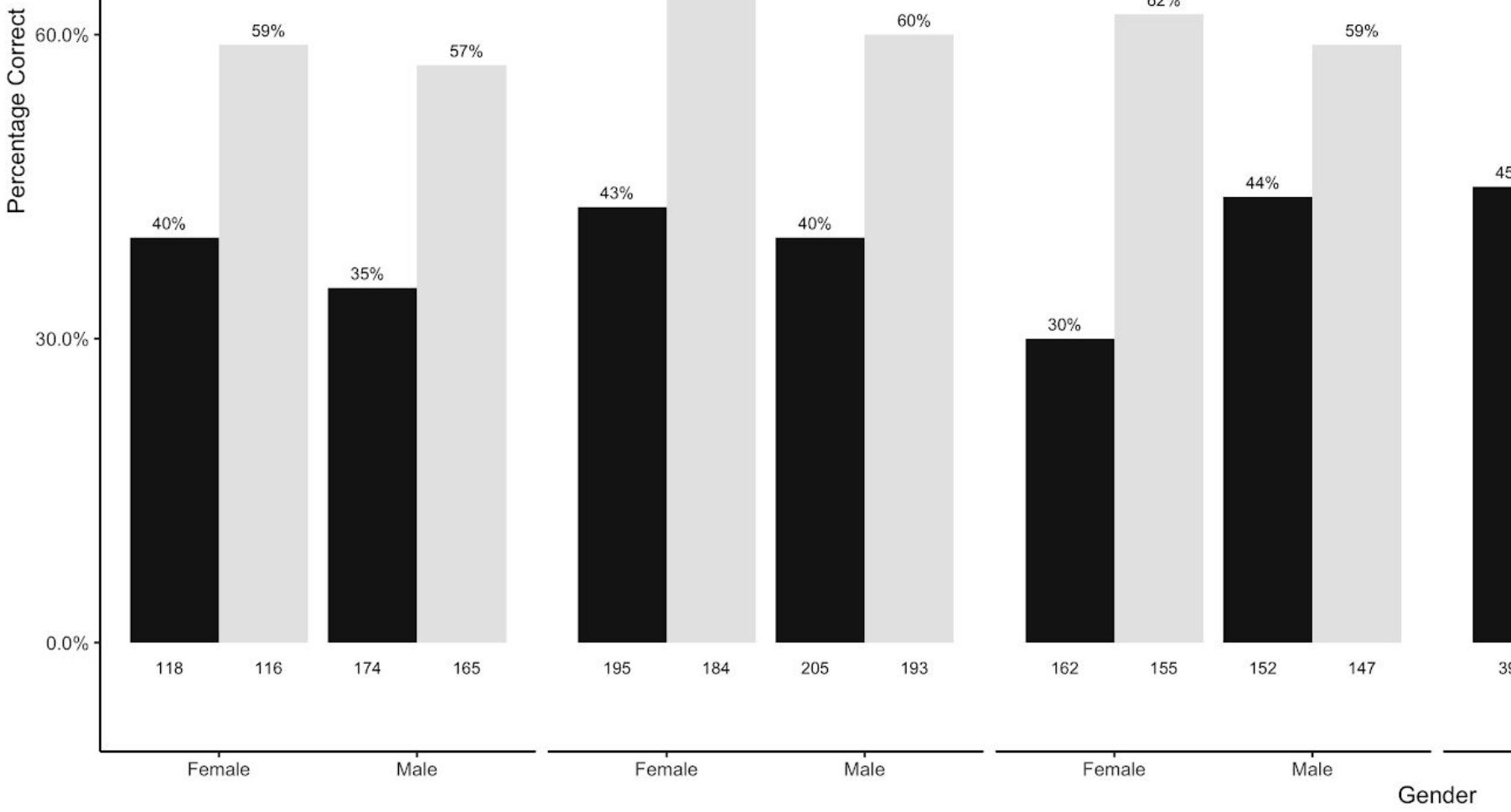
AEA Standards: Accuracy

Scenario:

Your team has worked long hours to generate a report.

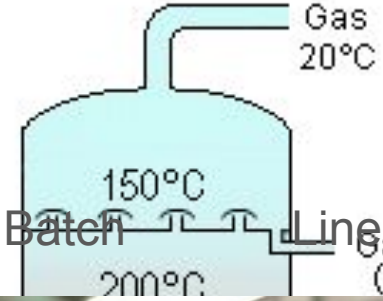
You've reviewed it, and you're meeting with the client.

The client asks, "Are you sure the ns are correct?"


Percentage Correct
60.0%
30.0%
0.0%
40%
59%
35%
57%
43%
60%
40%
62%
30%
59%
44%
118
116
174
165
195
184
205
193
162
155
152
147
Female
Male
Female
Male
Female
Male
Gender

Types of Processes

Project Job Shop Batch Line Continuous Flow



AEA Standards: Accuracy

```
content_items <- all_items %>%
  select(Grade, Gender, pre.post, q1, q2, q3) %>%
  na.omit() %>%
  group_by(Grade, Gender, pre.post, q1) %>%
  summarize(n = n()) %>%
  mutate(Total = sum(ct)) %>%
  mutate(Correct = round(ct/n,digits = 2)) %>%
  select(Grade, Gender, pre.post, Structure.chr, Correct, n) %>%
  spread(Structure.chr, Correct)
```