



Turning analysis on its head by turning cashflows on their side

Emily Riederer

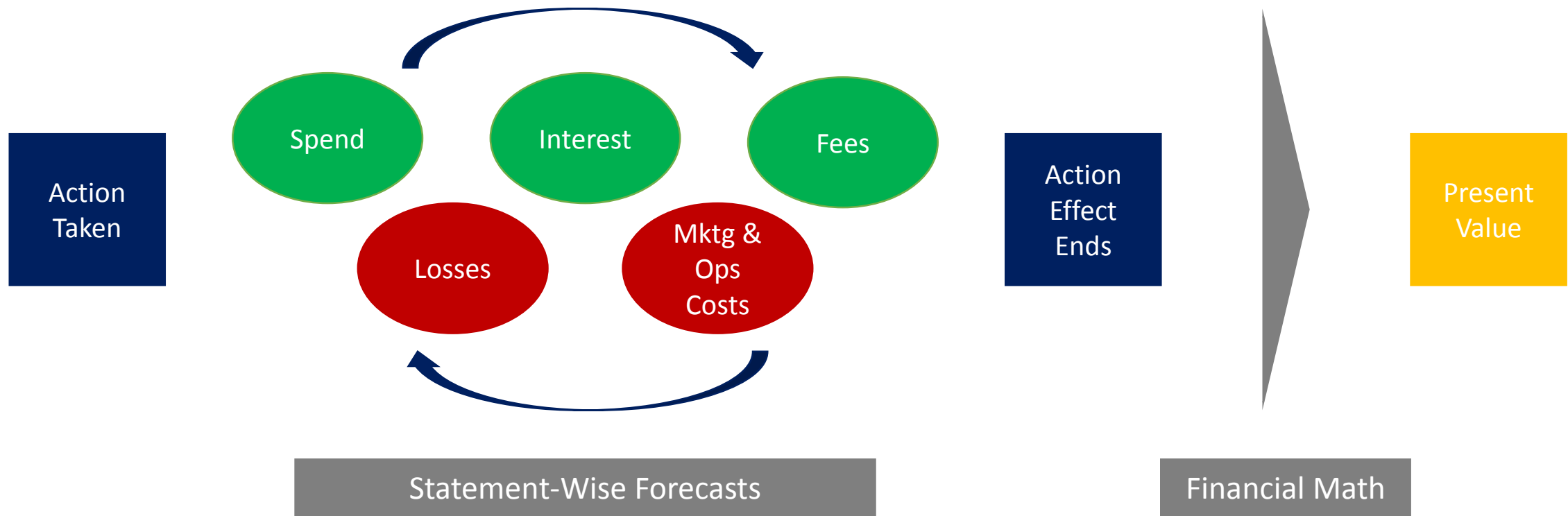
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@EmilyRiederer / emily.riederer@capitalone.com

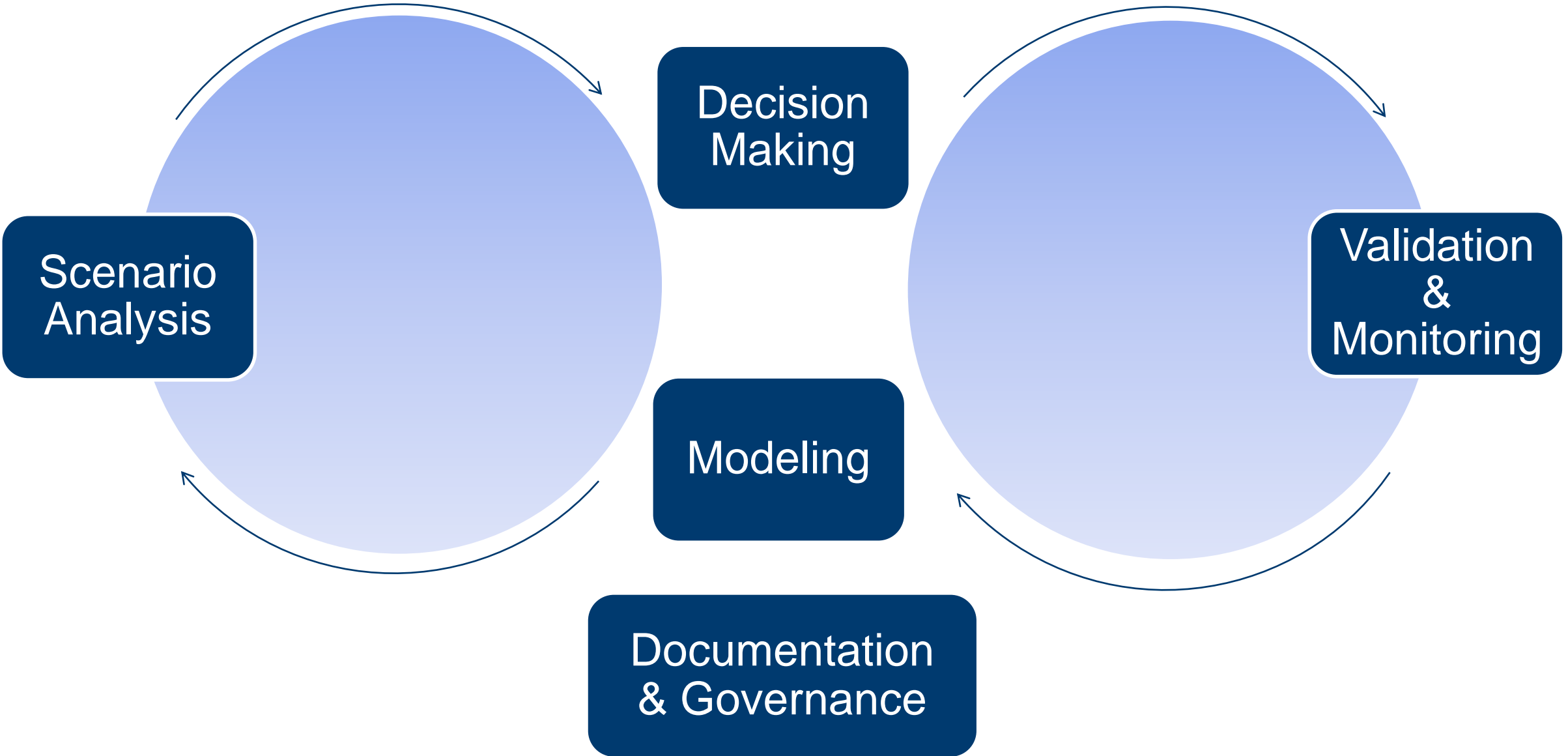
# business problem

valuations analysis at Capital One

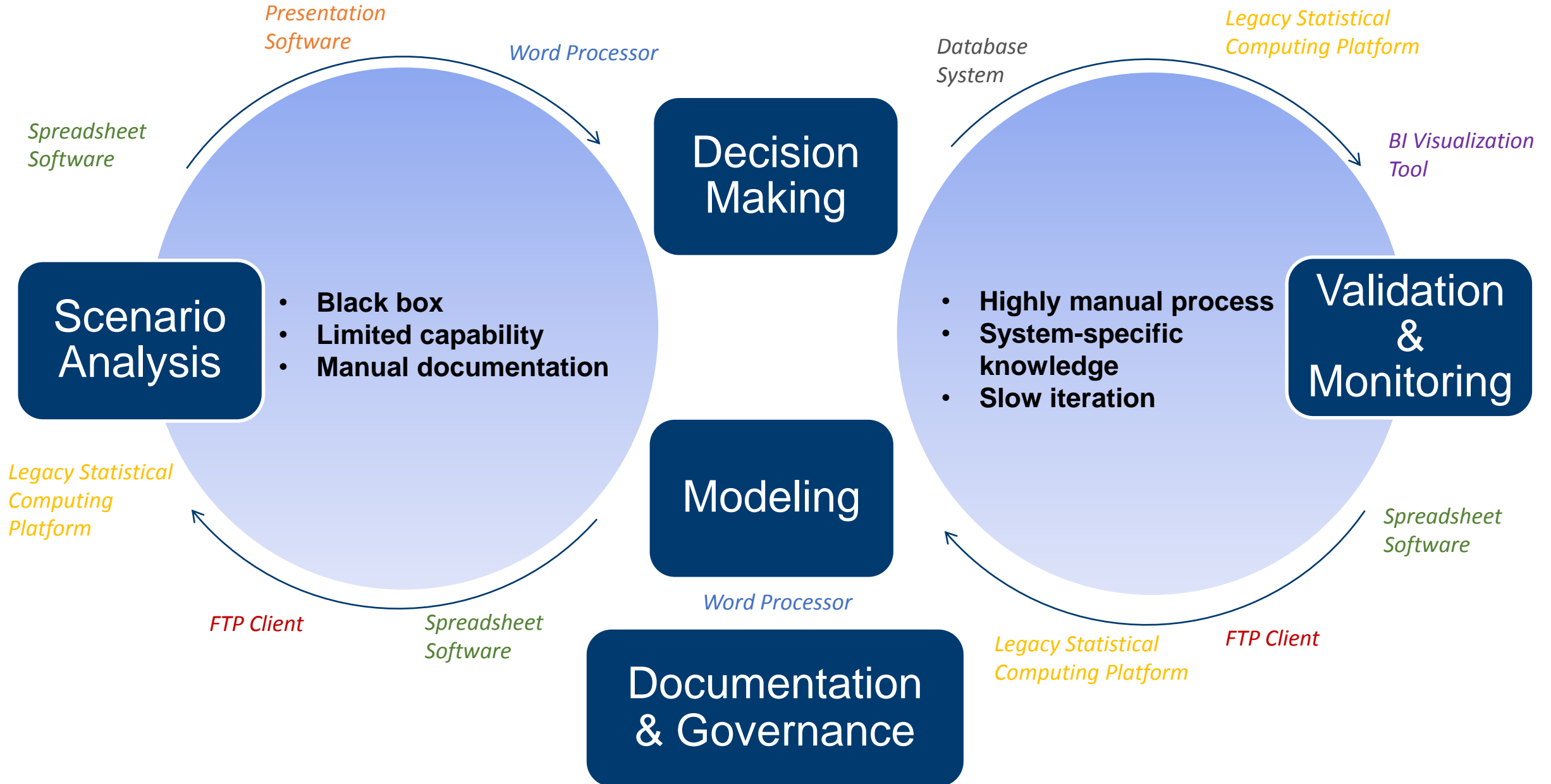
# Valuation models measure customer lifetime value by forecasting key components over time



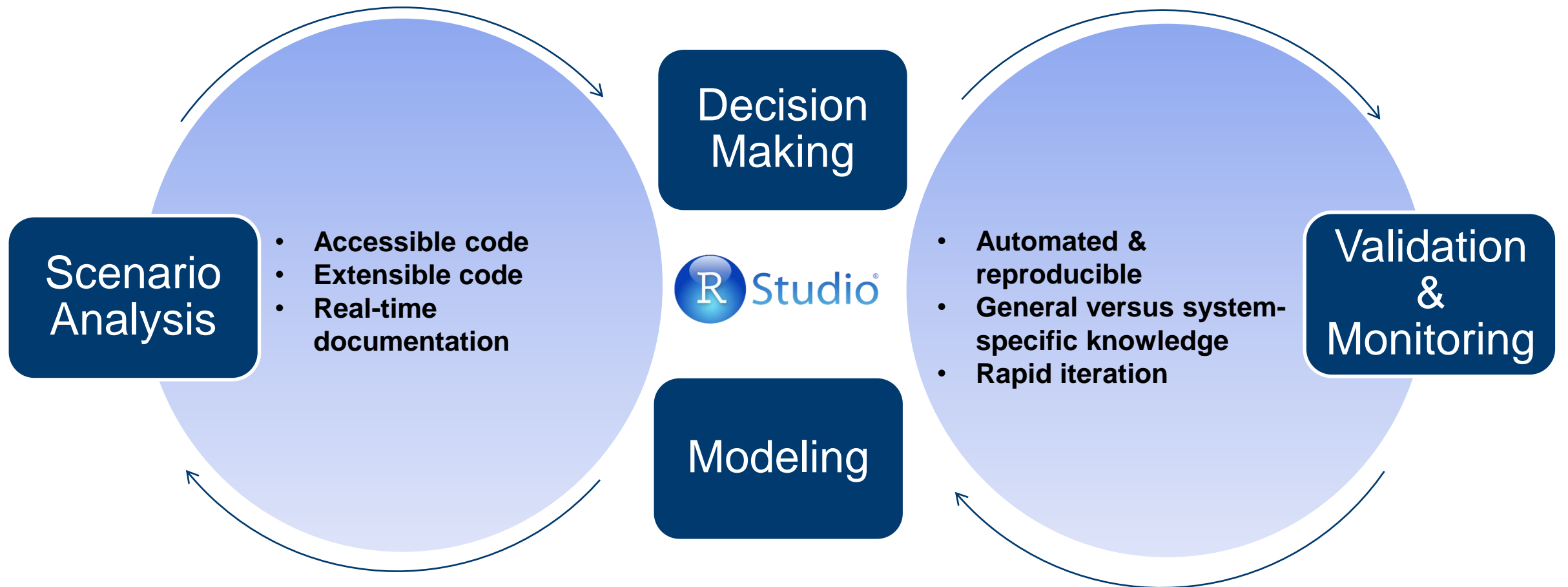
# Cashflow analysis is integral to many interrelated pieces of business analytics



# Tedious patchwork processes lead to poor documentation and impeded reproducibility



# Building an end-to-end R package enables an efficient and reproducible workflow

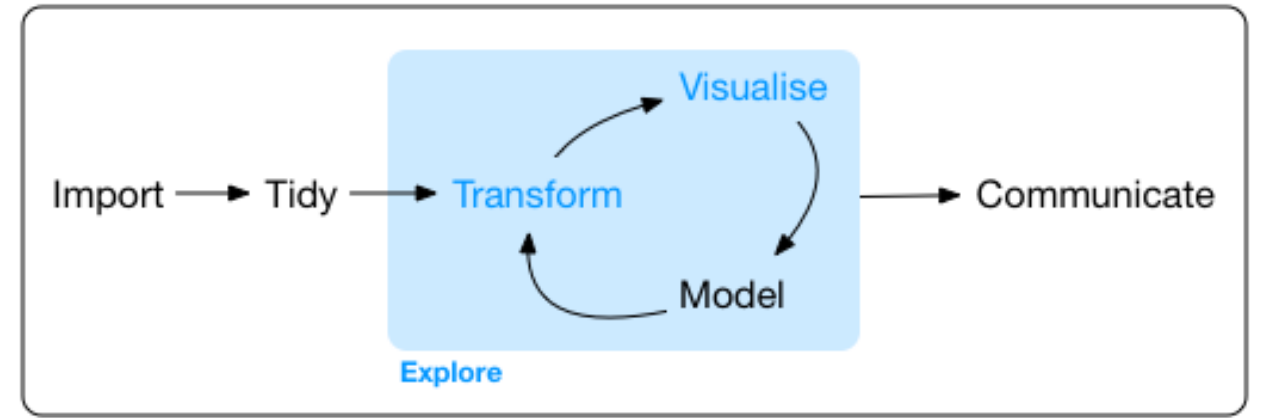
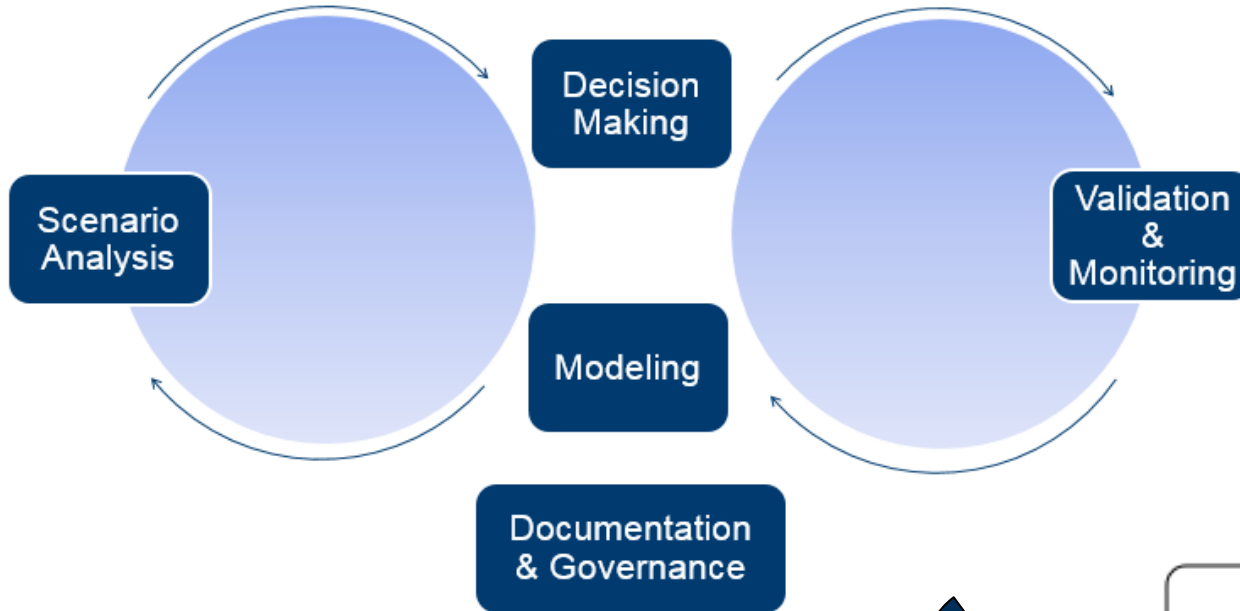


# rethinking cashflows

translating business analysis into a tidy data problem

# Nuanced business decisions are driven by a remarkably standard analytical “engine”

## Business Processes



Program

## Workflow

(R for Data Science)



# Cashflow statements are a typical representation of valuations models in the world of financial analysis

*Fake data is provided for illustrative purposes only and does not represent Capital One performance*

	Time Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<b>Total Revenue</b>		\$ 4.7	\$ 21.1	\$ 47.1	\$ 34.3	\$ 1.6	\$ 13.2	\$ 7.9	\$ 57.1	\$ 4.1	\$ 14.7	\$ 4.7	\$ 21.1	\$ 47.1	\$ 34.3	\$ 1.6	\$ 13.2	\$ 7.9	\$ 57.1
Interchange Revenue		\$ 2.0	\$ 19.5	\$ 45.8	\$ 31.7	\$ (0.7)	\$ 11.0	\$ 6.8	\$ 54.9	\$ 3.0	\$ 13.7	\$ 2.0	\$ 19.5	\$ 45.8	\$ 31.7	\$ (0.7)	\$ 11.0	\$ 6.8	\$ 54.9
<i>Spend</i>		\$ 195.4	\$ 1,945.4	\$ 4,583.6	\$ 3,174.0	\$ (71.5)	\$ 1,096.2	\$ 678.6	\$ 5,486.5	\$ 304.0	\$ 1,366.2	\$ 195.4	\$ 1,945.4	\$ 4,583.6	\$ 3,174.0	\$ (71.5)	\$ 1,096.2	\$ 678.6	\$ 5,486.5
<i>Interchange Rate</i>		1.0%																	
Interest Revenue		\$ 1.6	\$ 0.2	\$ 0.2	\$ 1.4	\$ 0.8	\$ 1.5	\$ 0.9	\$ 0.9	\$ 0.7	\$ 0.5	\$ 1.6	\$ 0.2	\$ 0.2	\$ 1.4	\$ 0.8	\$ 1.5	\$ 0.9	\$ 0.9
Fee Revenue		\$ 0.9	\$ 0.4	\$ 0.9	\$ 0.0	\$ 0.7	\$ 0.1	\$ 0.2	\$ 0.6	\$ 0.3	\$ 0.5	\$ 0.9	\$ 0.4	\$ 0.9	\$ 0.0	\$ 0.7	\$ 0.1	\$ 0.2	\$ 0.6
Other Revenues		\$ 0.3	\$ 1.0	\$ 0.1	\$ 1.1	\$ 0.8	\$ 0.6	\$ 0.1	\$ 0.7	\$ 0.1	\$ 0.1	\$ 0.3	\$ 1.0	\$ 0.1	\$ 1.1	\$ 0.8	\$ 0.6	\$ 0.1	\$ 0.7
<b>Total Expense</b>		\$ 14.2	\$ 3.2	\$ 9.9	\$ 2.0	\$ 8.9	\$ 10.9	\$ 5.0	\$ 1.6	\$ 16.0	\$ 19.9	\$ 14.2	\$ 3.2	\$ 9.9	\$ 2.0	\$ 8.9	\$ 10.9	\$ 5.0	\$ 1.6
Operating Expenses		\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0
Marketing Expenses		\$ 5.0	\$ 2.0	\$ -	\$ 1.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0	\$ 5.0	\$ 2.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0
Credit Losses		\$ -	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 1.0	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2
Recoveries & Coll		\$ -	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 2.0	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1
Cost of Funds		\$ 12.0	\$ 8.1	\$ 0.5	\$ 16.8	\$ 1.3	\$ 1.6	\$ 5.5	\$ 2.6	\$ 1.6	\$ 0.4	\$ 5.2	\$ 11.7	\$ 7.4	\$ 20.6	\$ 4.8	\$ 12.4	\$ 3.5	\$ 5.0
<i>Outstandings</i>		\$ 447.3	\$ 346.8	\$ 19.0	\$ 353.9	\$ 297.6	\$ 42.9	\$ 276.3	\$ 358.8	\$ 50.7	\$ 101.7	\$ 433.2	\$ 479.1	\$ 229.6	\$ 430.4	\$ 272.0	\$ 415.2	\$ 123.1	\$ 154.0
<i>Loan Rate</i>		2.7%	2.3%	2.6%	4.7%	0.4%	3.7%	2.0%	0.7%	3.1%	0.4%	1.2%	2.5%	3.2%	4.8%	1.8%	3.0%	2.9%	3.2%
Other Expenses		\$ (3.8)	\$ (8.2)	\$ 8.2	\$ (17.1)	\$ 4.3	\$ 7.0	\$ (3.7)	\$ (3.3)	\$ 11.1	\$ 17.3	\$ 0.0	\$ (11.9)	\$ (0.8)	\$ (20.9)	\$ 0.7	\$ (3.9)	\$ (1.8)	\$ (5.7)
<b>NIBT</b>		\$ (9.5)	\$ 17.9	\$ 37.1	\$ 32.4	\$ (7.3)	\$ 2.3	\$ 2.9	\$ 55.5	\$ (11.9)	\$ (5.2)	\$ (9.5)	\$ 17.9	\$ 37.1	\$ 32.4	\$ (7.3)	\$ 2.3	\$ 2.9	\$ 55.5
<b>Tax</b>		\$ (6.2)	\$ 11.6	\$ 24.1	\$ 21.1	\$ (4.7)	\$ 1.5	\$ 1.9	\$ 36.1	\$ (7.7)	\$ (3.4)	\$ (6.2)	\$ 11.6	\$ 24.1	\$ 21.1	\$ (4.7)	\$ 1.5	\$ 1.9	\$ 36.1
<i>Tax Rate</i>		36.0%																	
<b>NIAT</b>		\$ (3.3)	\$ 6.3	\$ 13.0	\$ 11.3	\$ (2.6)	\$ 0.8	\$ 1.0	\$ 19.4	\$ (4.2)	\$ (1.8)	\$ (3.3)	\$ 6.3	\$ 13.0	\$ 11.3	\$ (2.6)	\$ 0.8	\$ 1.0	\$ 19.4
Equity Flow		\$ (5.0)	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ (5.0)	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0
Cashflow		\$ (8.3)	\$ 7.3	\$ 14.0	\$ 12.3	\$ (1.6)	\$ 1.8	\$ 2.0	\$ 20.4	\$ (3.2)	\$ 4.0	\$ (8.3)	\$ 7.3	\$ 14.0	\$ 12.3	\$ (1.6)	\$ 1.8	\$ 2.0	\$ 20.4
<b>Discounted CF</b>		\$ (8.3)	\$ 7.2	\$ 13.8	\$ 12.1	\$ (1.5)	\$ 1.7	\$ 1.9	\$ 19.5	\$ (3.0)	\$ 3.8	\$ (8.3)	\$ 7.2	\$ 13.8	\$ 12.1	\$ (1.5)	\$ 1.7	\$ 1.9	\$ 19.5
Lifetime DCF		\$ 47.2																	
TV		\$ 10.0																	
PV		\$ 57.2																	

# However, cashflow statements are not optimized for either human or machine readability

*Fake data is provided for illustrative purposes only and does not represent Capital One performance*

Time

Time Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Total Revenue	\$ 4.7	\$ 21.1	\$ 47.1	\$ 34.3	\$ 1.6	\$ 13.2	\$ 7.9	\$ 57.1	\$ 4.1	\$ 14.7	\$ 4.7	\$ 21.1	\$ 47.1	\$ 34.3	\$ 1.6	\$ 13.2	\$ 7.9	\$ 57.1
Interchange Revenue	\$ 2.0	\$ 19.5	\$ 45.8	\$ 31.7	\$ (0.7)	\$ 11.0	\$ 6.8	\$ 54.9	\$ 3.0	\$ 13.7	\$ 2.0	\$ 19.5	\$ 45.8	\$ 31.7	\$ (0.7)	\$ 11.0	\$ 6.8	\$ 54.9
Spend	\$ 195.4	\$ 1,945.4	\$ 4,583.6	\$ 3,174.0	\$ (71.5)	\$ 1,096.2	\$ 678.6	\$ 5,486.5	\$ 304.0	\$ 1,366.2	\$ 195.4	\$ 1,945.4	\$ 4,583.6	\$ 3,174.0	\$ (71.5)	\$ 1,096.2	\$ 678.6	\$ 5,486.5
Interchange Rate	1.0%																	
Interest Revenue	\$ 1.6	\$ 0.2	\$ 0.2	\$ 1.4	\$ 0.8	\$ 1.5	\$ 0.9	\$ 0.9	\$ 0.7	\$ 0.5	\$ 1.6	\$ 0.2	\$ 0.2	\$ 1.4	\$ 0.8	\$ 1.5	\$ 0.9	\$ 0.9
Fee Revenue	\$ 0.9	\$ 0.4	\$ 0.9	\$ 0.0	\$ 0.7	\$ 0.1	\$ 0.2	\$ 0.6	\$ 0.3	\$ 0.5	\$ 0.9	\$ 0.4	\$ 0.9	\$ 0.0	\$ 0.7	\$ 0.1	\$ 0.2	\$ 0.6
Other Revenues	\$ 0.3	\$ 1.0	\$ 0.1	\$ 1.1	\$ 0.8	\$ 0.6	\$ 0.1	\$ 0.7	\$ 0.1	\$ 0.1	\$ 0.3	\$ 1.0	\$ 0.1	\$ 1.1	\$ 0.8	\$ 0.6	\$ 0.1	\$ 0.7
Total Expense	\$ 14.2	\$ 3.2	\$ 9.9	\$ 2.0	\$ 8.9	\$ 10.9	\$ 5.0	\$ 1.6	\$ 16.0	\$ 19.9	\$ 14.2	\$ 3.2	\$ 9.9	\$ 2.0	\$ 8.9	\$ 10.9	\$ 5.0	\$ 1.6
Operating Expenses	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0
Marketing Expenses	\$ 5.0	\$ 2.0	\$ -	\$ 1.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0	\$ 5.0	\$ 2.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0	\$ 2.0	\$ 1.0
Credit Losses	\$ -	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 1.0	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2	\$ 0.2
Recoveries & Coll	\$ -	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 2.0	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1	\$ 0.1
Cost of Funds	\$ 12.0	\$ 8.1	\$ 0.5	\$ 16.8	\$ 1.3	\$ 1.6	\$ 5.5	\$ 2.6	\$ 1.6	\$ 0.4	\$ 5.2	\$ 11.7	\$ 7.4	\$ 20.6	\$ 4.8	\$ 12.4	\$ 3.5	\$ 5.0
Outstandings	\$ 447.3	\$ 915.0	\$ 183.0	\$ 366.0	\$ 73.2	\$ 146.4	\$ 292.8	\$ 585.6	\$ 117.1	\$ 234.2	\$ 479.1	\$ 958.2	\$ 1916.4	\$ 3832.8	\$ 7665.6	\$ 15331.2	\$ 30662.4	\$ 61324.8
Loan Rate	2.7%	2.3%	2.6%	4.7%	0.4%	3.7%	2.0%	0.7%	3.1%	0.4%	1.2%	2.5%	3.2%	4.8%	1.8%	3.0%	2.9%	3.2%
Other Expenses	\$ (3.8)	\$ (8.2)	\$ 8.2	\$ (17.1)	\$ 4.3	\$ 7.0	\$ (3.7)	\$ (3.3)	\$ 11.1	\$ 17.3	\$ 0.0	\$ (11.9)	\$ (0.8)	\$ (20.9)	\$ 0.7	\$ (3.9)	\$ (1.8)	\$ (5.7)
NIBT	\$ (9.5)	\$ 17.9	\$ 37.1	\$ 32.4	\$ (7.3)	\$ 2.3	\$ 2.9	\$ 55.5	\$ (11.9)	\$ (5.2)	\$ (9.5)	\$ 17.9	\$ 37.1	\$ 32.4	\$ (7.3)	\$ 2.3	\$ 2.9	\$ 55.5
Tax	\$ (6.2)	\$ 11.6	\$ 24.1	\$ 21.1	\$ (4.7)	\$ 1.5	\$ 1.9	\$ 36.1	\$ (7.7)	\$ (3.4)	\$ (6.2)	\$ 11.6	\$ 24.1	\$ 21.1	\$ (4.7)	\$ 1.5	\$ 1.9	\$ 36.1
Tax Rate	36.0%																	
NIAT	\$ (3.3)	\$ 6.3	\$ 13.0	\$ 11.3	\$ (2.6)	\$ 0.8	\$ 1.0	\$ 19.4	\$ (4.2)	\$ (1.8)	\$ (3.3)	\$ 6.3	\$ 13.0	\$ 11.3	\$ (2.6)	\$ 0.8	\$ 1.0	\$ 19.4
Equity Flow	\$ (5.0)	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ (5.0)	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0	\$ 1.0
Cashflow	\$ (8.3)	\$ 7.3	\$ 14.0	\$ 12.3	\$ (1.6)	\$ 1.8	\$ 2.0	\$ 20.4	\$ (3.2)	\$ 4.0	\$ (8.3)	\$ 7.3	\$ 14.0	\$ 12.3	\$ (1.6)	\$ 1.8	\$ 2.0	\$ 20.4
Discounted CF	\$ (8.3)	\$ 7.2	\$ 13.8	\$ 12.1	\$ (1.5)	\$ 1.7	\$ 1.9	\$ 19.5	\$ (3.0)	\$ 3.8	\$ (8.3)	\$ 7.2	\$ 13.8	\$ 12.1	\$ (1.5)	\$ 1.7	\$ 1.9	\$ 19.5
Lifetime DCF	\$ 47.2																	
TV	\$ 10.0																	
PV	\$ 57.2																	

Variable information contained in formatting – bold, italics, indentations

Mix of data and calculations, with every cell exposed to potential typos

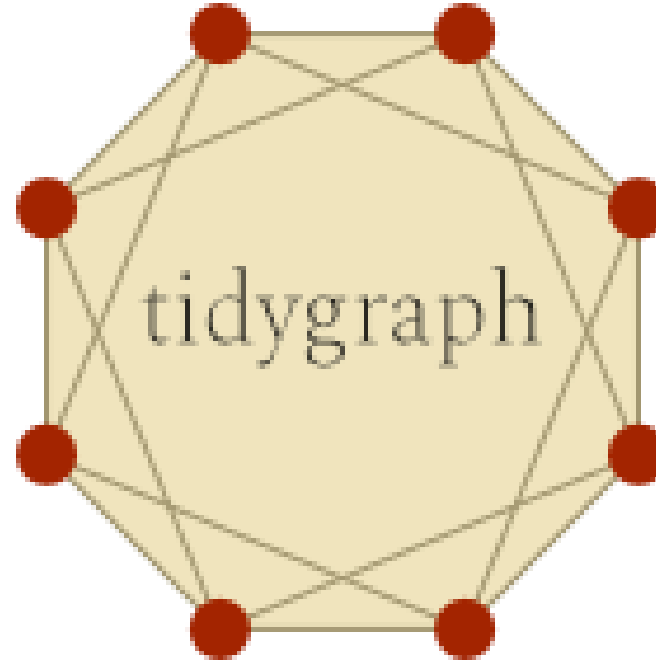
Mix of time series and pointwise fields; data and assumptions

Data defined by specific location on sheet so adding a new line-item can perturb downstream calculations

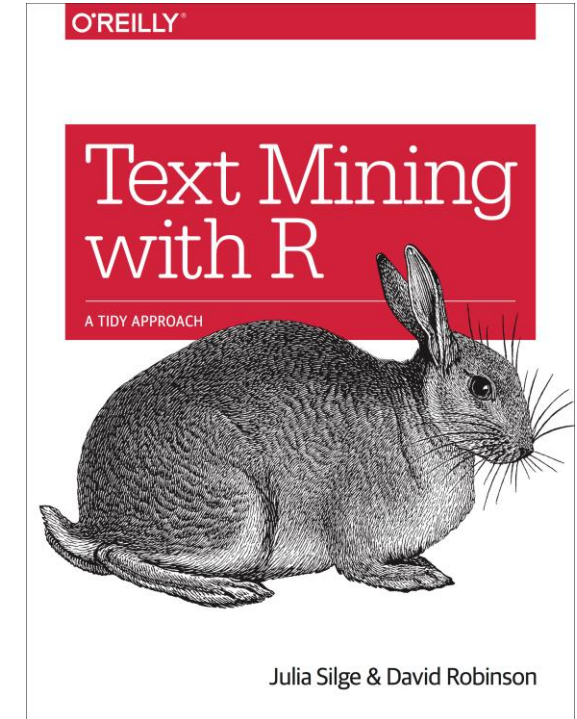
Exceptional packages of the tidyverse's extended family suggested that there must be a better way



**Tidy Model Outputs**  
**David Robinson**



**Tidy Network Analysis**  
**Thomas Lin Pedersen**



**Tidy Text Mining**  
**Julia Silge & David Robinson**

# Why *tidy* cashflows? Represent data as data

*Fake data is provided for illustrative purposes only and does not represent Capital One performance*

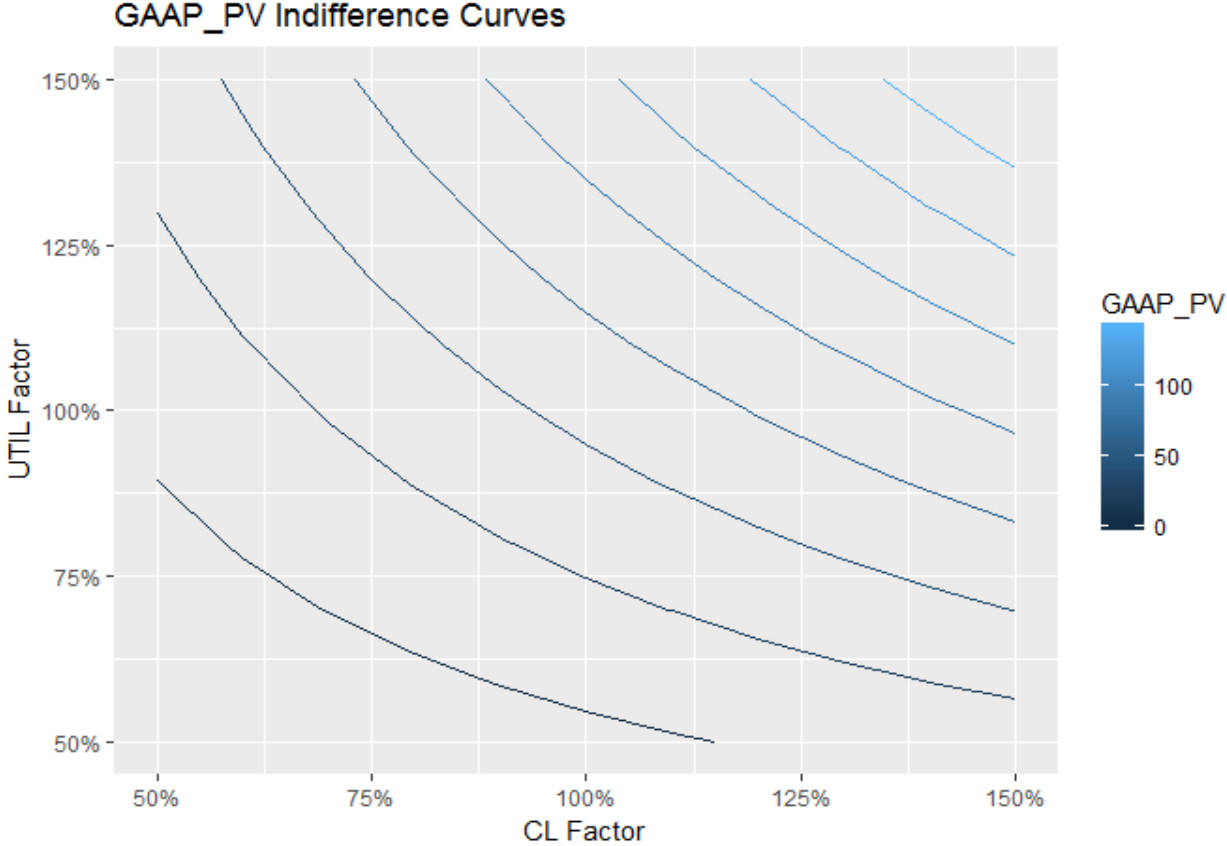
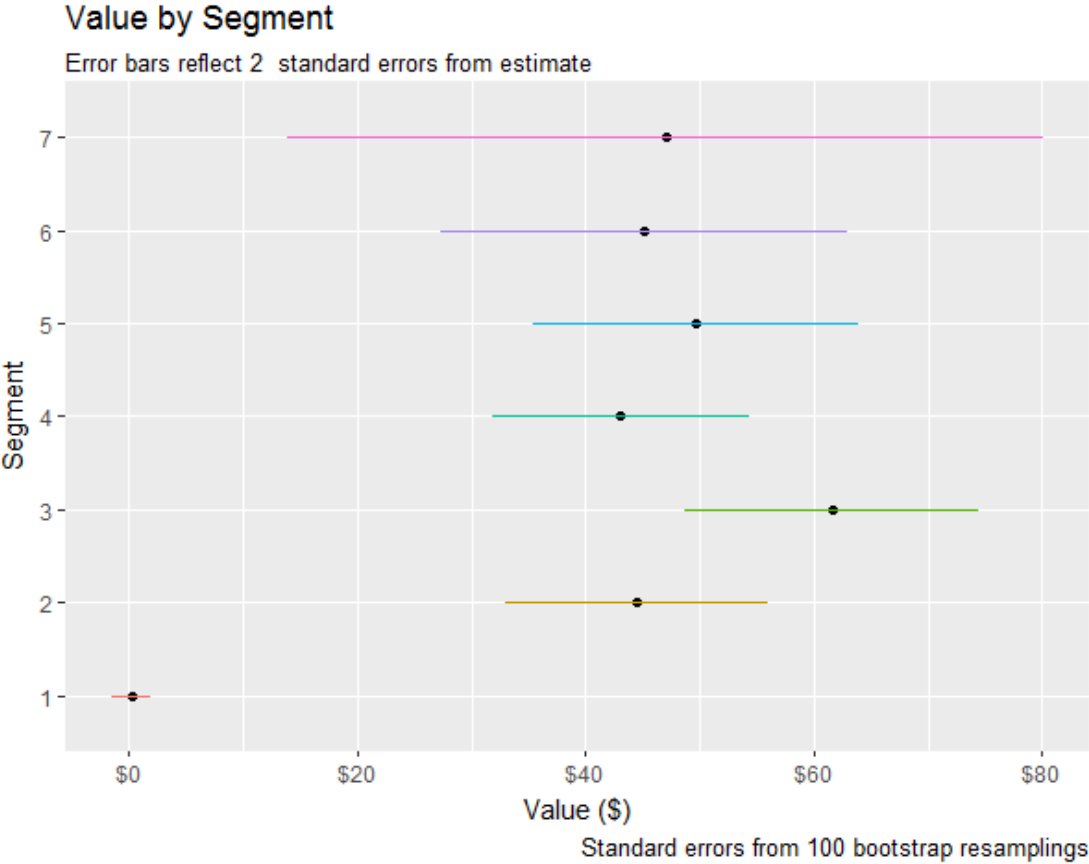
	Time	1	2	3	4	5
<b><i>Superprime</i></b>						
Total Revenue		\$4.69	\$21.08	\$47.07	\$34.35	\$1.59
Total Expense		\$14.20	\$3.19	\$9.94	\$1.96	\$8.89
NIBT		-\$9.50	\$17.90	\$37.13	\$32.39	-\$7.30
Tax		-\$6.18	\$11.63	\$24.13	\$21.05	-\$4.75
NIAT		-\$3.33	\$6.26	\$13.00	\$11.34	-\$2.56
Equity Flow		-\$5.00	\$1.00	\$1.00	\$1.00	\$1.00
Cashflow		-\$8.33	\$7.26	\$14.00	\$12.34	-\$1.56
<b><i>Prime</i></b>						
Total Revenue		\$57.61	\$93.78	\$17.74	\$36.98	\$78.72
Total Expense		\$47.45	\$5.52	\$54.17	\$3.93	\$55.98
NIBT		\$10.16	\$88.26	-\$36.43	\$33.05	\$22.74
Tax		\$6.60	\$57.37	-\$23.68	\$21.48	\$14.78
NIAT		\$3.56	\$30.89	-\$12.75	\$11.57	\$7.96
Equity Flow		-\$5.00	\$1.00	\$1.00	\$1.00	\$1.00
Cashflow		-\$1.44	\$31.89	-\$11.75	\$12.57	\$8.96



Segment	Time	Tot_Rev	Tot_Exp	NIBT	Tax	NIAT	Eq_Flow	Cashflow
Super	1	4.69	14.20	-9.50	-6.18	-3.33	-5.00	-8.33
Super	2	21.08	3.19	17.90	11.63	6.26	1.00	7.26
Super	3	47.07	9.94	37.13	24.13	13.00	1.00	14.00
Super	4	34.35	1.96	32.39	21.05	11.34	1.00	12.34
Super	5	1.59	8.89	-7.30	-4.75	-2.56	1.00	-1.56
Prime	1	57.61	47.45	10.16	6.60	3.56	-5.00	-1.44
Prime	2	93.78	5.52	88.26	57.37	30.89	1.00	31.89
Prime	3	17.74	54.17	-36.43	-23.68	-12.75	1.00	-11.75
Prime	4	36.98	3.93	33.05	21.48	11.57	1.00	12.57
Prime	5	78.72	55.98	22.74	14.78	7.96	1.00	8.96

# Tidy cashflows streamline the workflow to facilitate advanced analytics like bootstrapping error bars and indifference curves

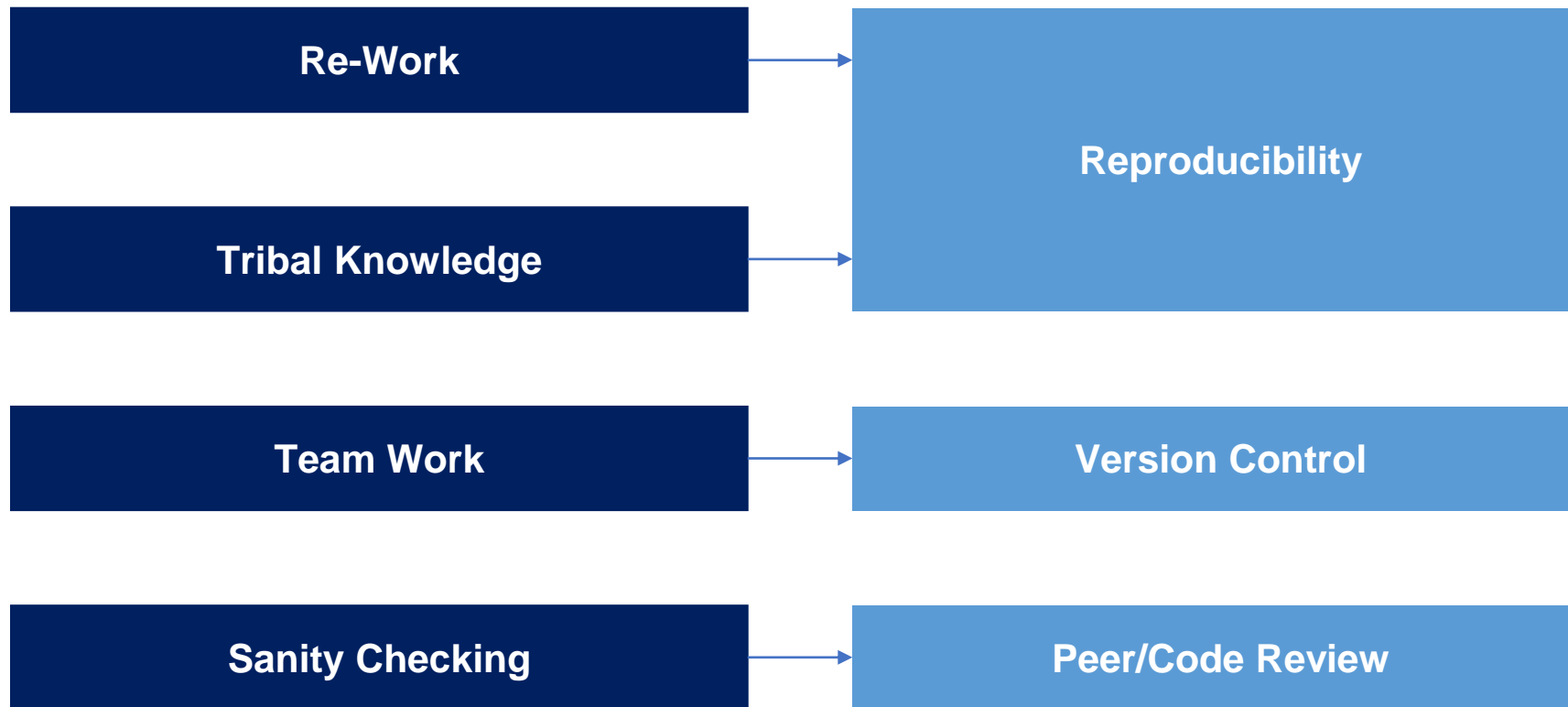
*Fake data is provided for illustrative purposes only and does not represent Capital One performance*



# the anatomy of an initiative

package development meets people development

# Beyond tidy data structures, we sought to reinvent our processes to fully accept the tidyverse philosophy and best practices of reproducible research



To complete the journey and transform our analysts, we prioritized values learned from apparent tidyverse and RStudio in our design

## Empathy

*design to meet users' needs*

## Empowerment

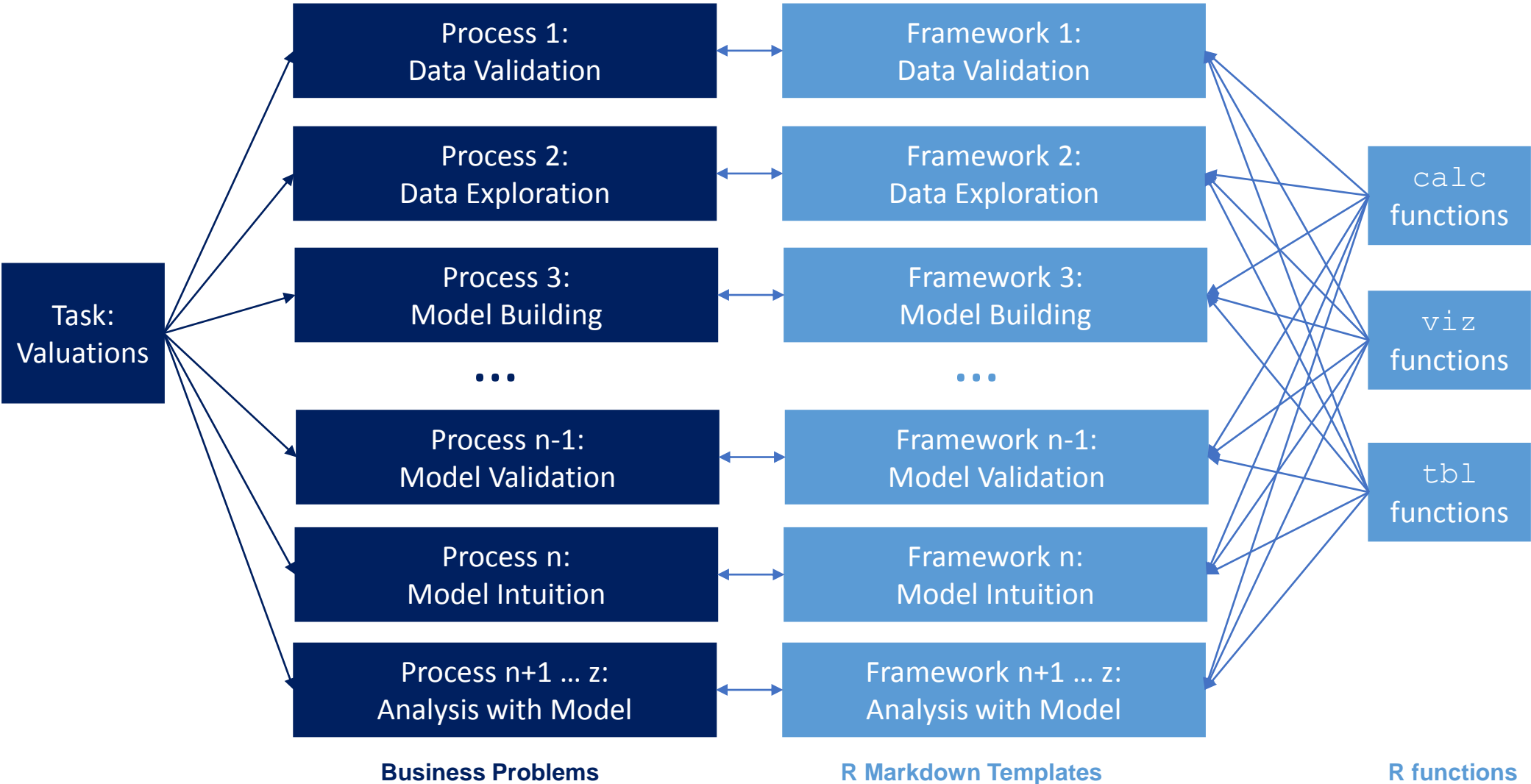
*design to teach and facilitate*

## Engagement

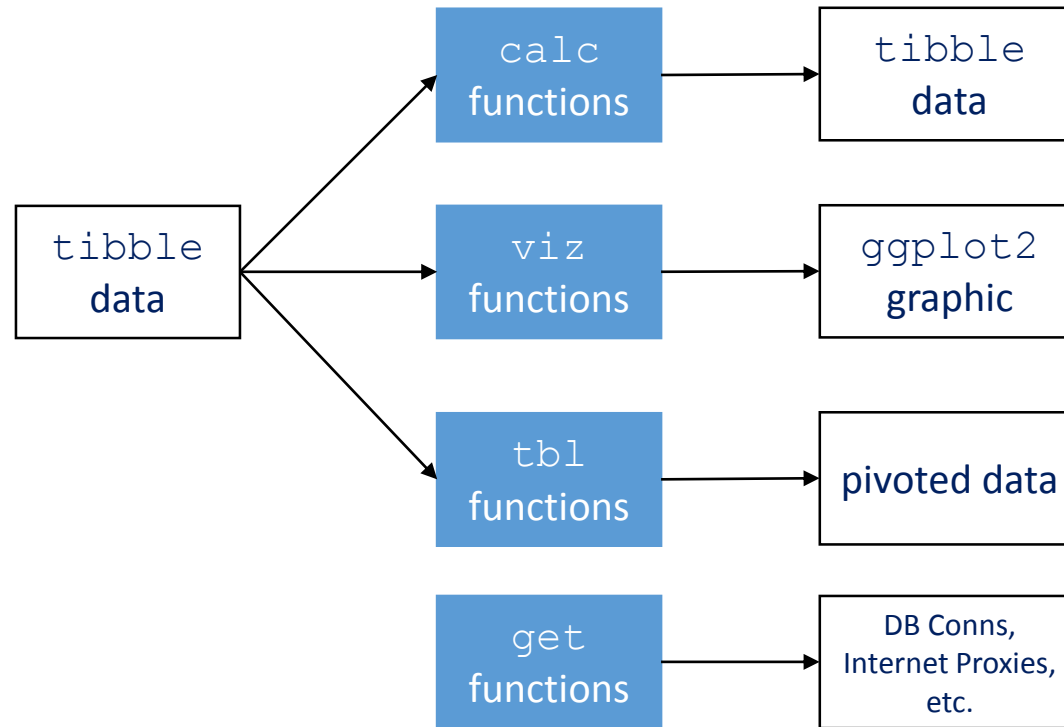
*design for extension with invitation to contribute*



# Organically evolving the `tidycf` package while addressing business problems led to efficient and *empathetic* development



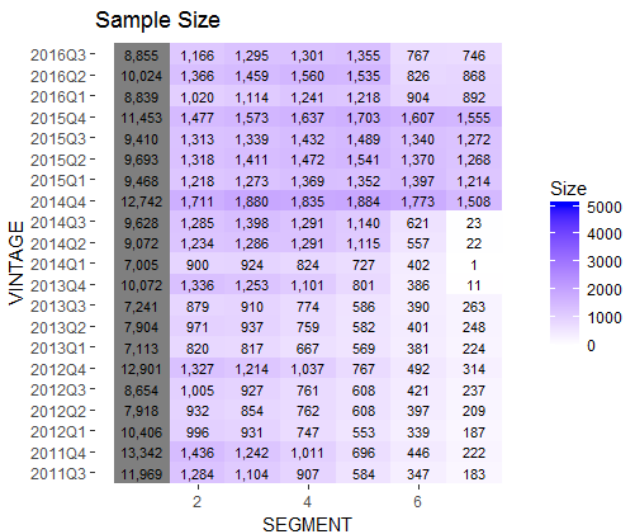
# Functions manipulate tidy data and provide output consistent with their taxonomy and compatible with any tidyverse pipeline



# These functions are intuitively related to help users quickly generate common views

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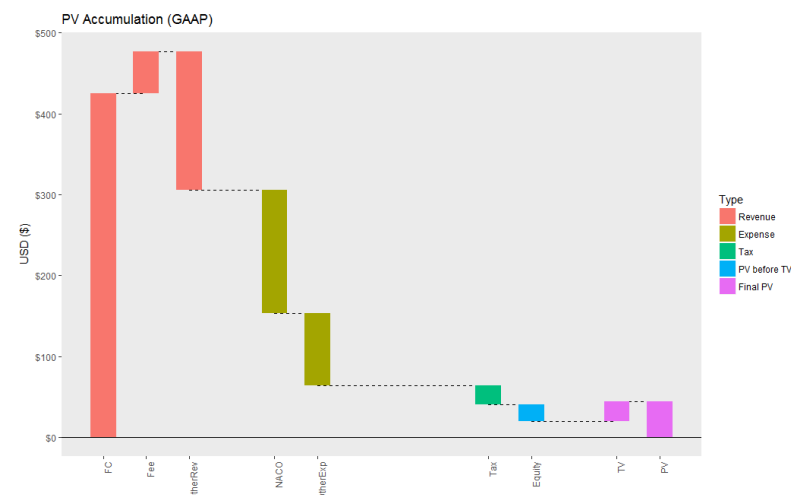
```
> raw_data %>%
+   viz_sample_size()
```



```
> cfs %>%
+   filter(SEGMENT == 3) %>%
+   calc_wf()
```

```
# A tibble: 9 x 3
  SUBGROUP VALUE COMPONENT
<fctr> <dbl> <fctr>
1 FC 424.59 Revenue
2 Fee 52.23 Revenue
3 OtherRev -171.54 Revenue
4 NACO -152.47 Expense
5 OtherExp -88.45 Expense
6 Tax -23.69 Tax
7 Equity -21.29 PV before TV
8 TV 25.06 Final PV
9 PV 44.44 Final PV
```

```
> cfs %>%
+   filter(SEGMENT == 3) %>%
+   calc_wf() %>%
+   viz_wf()
```



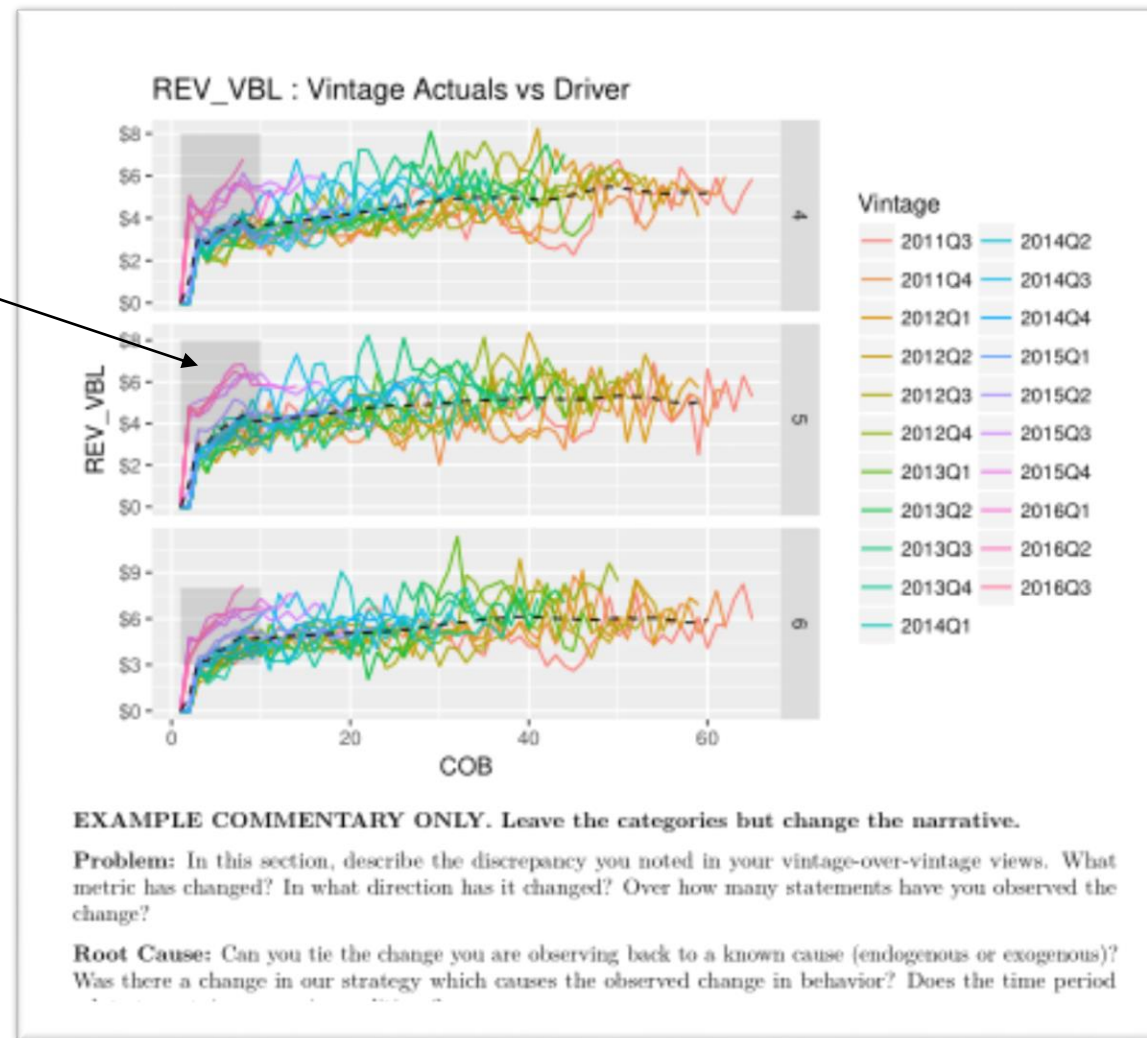
```
> raw_data %>%
+   tbl_sample_size()
# A tibble: 21 x 8
  VINTAGE `1` `2` `3` `4` `5` `6` `7`
* <chr> <int> <int> <int> <int> <int> <int> <int>
1 2011Q3 11969 1284 1104 907 584 347 183
2 2011Q4 13342 1436 1242 1011 696 446 222
3 2012Q1 10406 996 931 747 553 339 187
4 2012Q2 7918 932 854 762 608 397 209
5 2012Q3 8654 1005 927 761 608 421 237
6 2012Q4 12901 1327 1214 1037 767 492 314
7 2013Q1 7113 820 817 667 569 381 224
8 2013Q2 7904 971 937 759 582 401 248
9 2013Q3 7241 879 910 774 586 390 263
10 2013Q4 10072 1336 1253 1101 801 386 11
# ... with 11 more rows
```

# RMarkdown templates *empower* users through R language immersion and corporate knowledge-transfer

Code comments explain syntax and suggest new functions to try

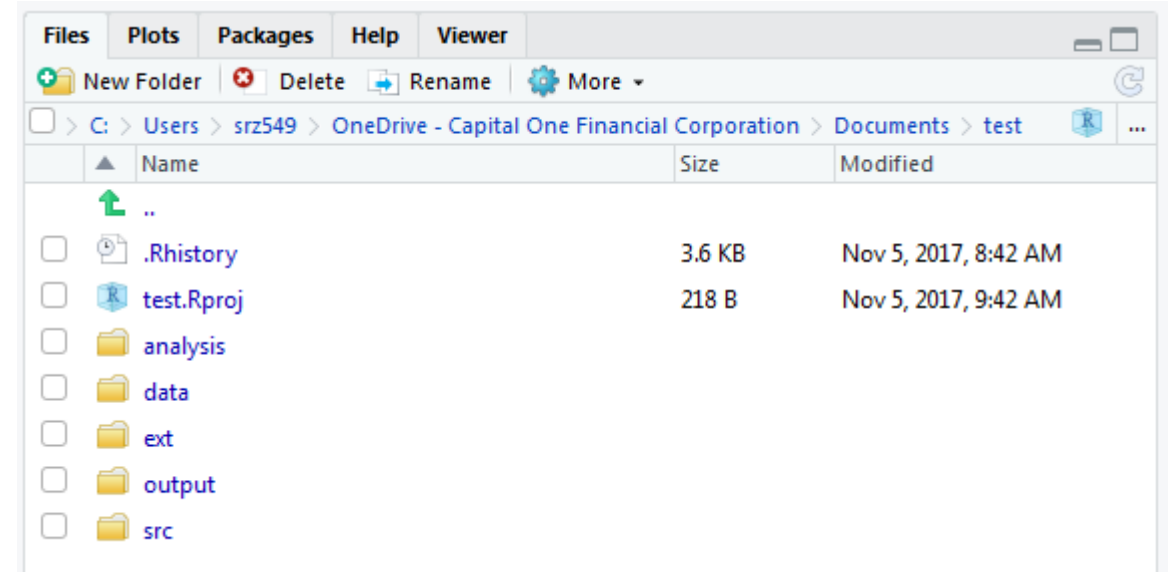
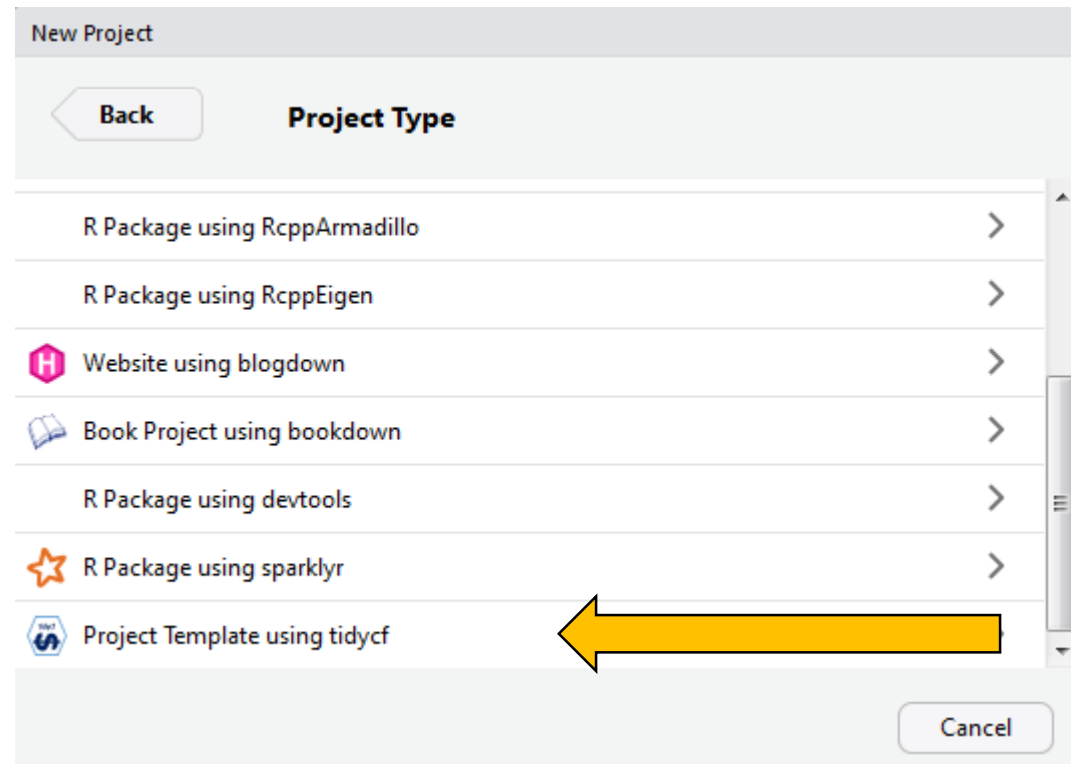
```
analysis.Rmd x
46 ## Problem Statement
47
48 **ADD COMMENTARY HERE**
49
50 ```{r}
51 viz_vintages(actuals,
52              "REV_VBL", "dollar",
53              seg_list = c(4,5,6),
54              drivers)+
55 # ggplot2::annotate can add call-out box to graph
56 annotate("rect", alpha = 0.2,
57        xmin=1, xmax=10,
58        ymin=3, ymax=8)
59
60
61 **EXAMPLE COMMENTARY ONLY. Leave the categories but change the narrative.**
62
63 **Problem:** In this section, describe the discrepancy you noted in your
64 vintage-over-vintage views. What metric has changed? In what direction has it changed?
65 Over how many statements have you observed the change?
66
67 **Root Cause:** Can you tie the change you are observing back to a known cause (endogenous
68 or exogenous)? Was there a change in our strategy which causes the observed change in
69 behavior? Does the time period relate to certain economic conditions?
70
71 **Persistence:** Based on the root cause you determined, do you have reason to think this
72 change will persist? Is there evidence that future data will appear more in-line with the
73 new level and/or trend than the old?
74
75 **Magnitude:** How meaningful is this discrepancy? Is the magnitude large enough to merit
76 altering the model? More specifically, would believing that we will see the new trends
77 versus the old trend in the future significantly change our decision-making?
78
79 ## Key Questions
80
81 Key Questions
```

Text commentary facilitates knowledge transfer of business context and intuition



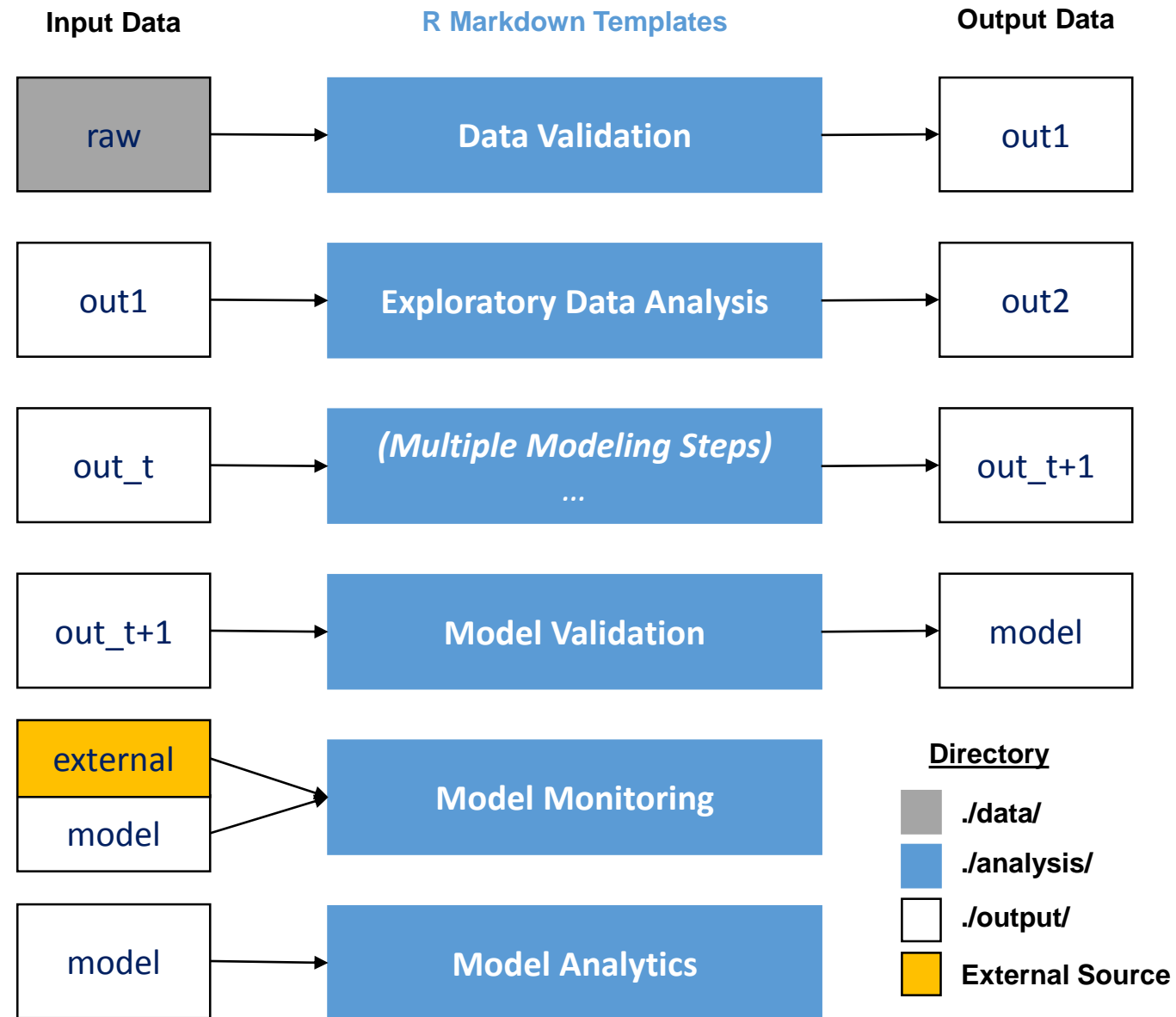
# tidycf's R Project template standardizes file structure for better project management

## RStudio > File > New Project > New Directory



- **/analysis/** : core scripts (.Rmd) and final outputs (.HTML)
- **/data/** : raw data
- **/doc/**: text files with context and documentation
- **/ext/** : external files needed for project
- **/output/** : intermediate/final data formats
- **/src/** : other helper scripts (e.g. SQL, python)

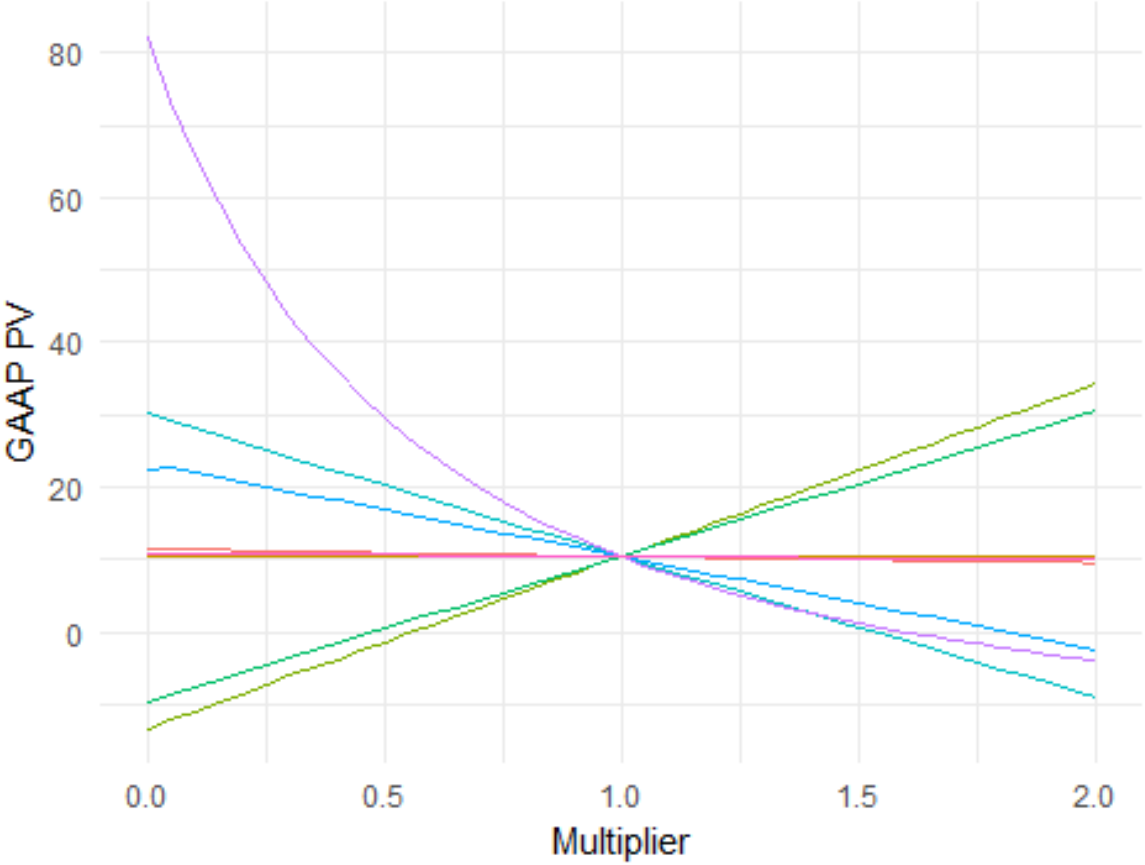
# Opinionated RMarkdown templates read and save artifacts in appropriate directories



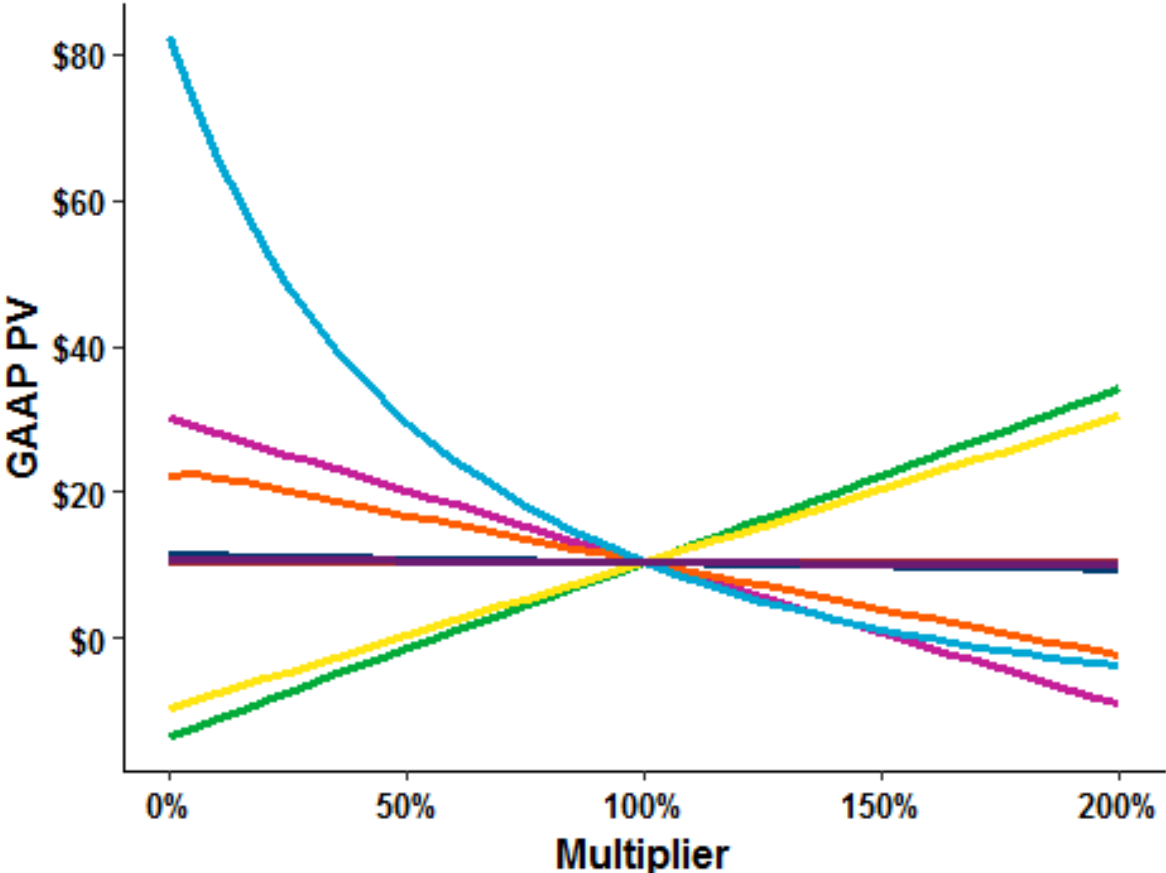
# Highlighting potential enhancements (e.g. hex sticker, ggp1ot2 theme, new RMarkdown template) engages users with the possibility to contribute

*Fake data is provided for illustrative purposes only and does not represent Capital One performance*

### Univariate Sensitivity Analysis



### Univariate Sensitivity Analysis











Turning analysis on its head by turning cashflows on their side

Emily Riederer

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