



Using Excel to Facilitate JCL Analyses 2023 NASA Cost and Schedule Symposium

by
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Introduction

Have you ever been in an SRB meeting trying to field questions such as:

- What does our baseline case look like when compared with a case where the estimates for risk X are twice (or half) the estimate by the project?
- What does Case A look like when compared to Case B?
- What does our worst case look like when compared to our best case?
- What does it look like when all uncertainties are changed to "x" and compared to the baseline case? To case A? to Case B?
- What would be required to mitigate risk A, B or C, or all together to get the launch date back into a reasonable likelihood of achieving?
- [Mars Missions] What is the likelihood of launching in the launch window, ready before the window, miss the window?



Current NASA Monte Carlo schedule analysis tools have good graphical output capabilities – however:

- Ponderous for quick response to questions regarding comparisons of cases.
- Don't readily support graphical display of information unique to a specific project.

Need led to the development of the Scatterplotter post-processor

What is the Scatterplot Post-Processor?

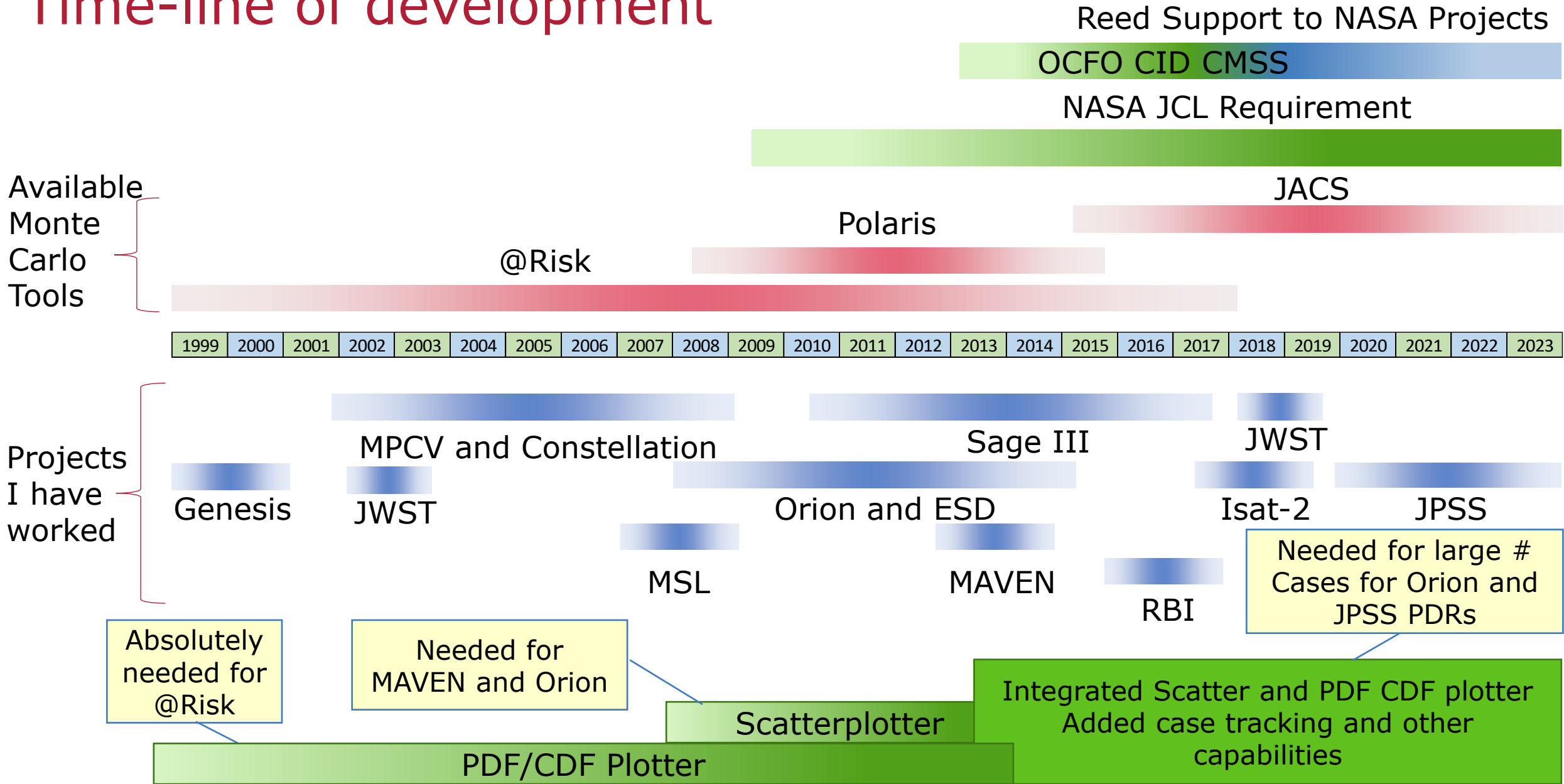
Excel is very capable and flexible

- Scatterplotter slowly developed over about 20 years, driven by need.
- Quick turnaround for comparing cases.
 - Can be hyperlinked to the PowerPoint or Word report for rapid production.
- Easily construct unique displays of cases.
 - Add data from previous reviews, or from other sources.
 - Easily adjust axes of plots – re-scale, even numbers for axes, move to show other relevant data, show MA, ABC or plan values for dates/\$s.
- Facilitates record-keeping, all cases are in one workbook, well documented – as opposed to collections of separate files in a computer.

Topics

- Why/how it was developed
- Structure of Excel workbook
 - How to use it
 - Next steps?

Time-line of development




Continuing Development

Current status of publicly-funded version

- Developed as needed to do the job.
- Facilitates assessment and reporting Helps organize and keep track of analysis cases.
- Klutzy to use, needs a lot of manual manipulation – copying to new case tab, downloading scatterplot data file, PDF and CDF data files ... etc.
- Some re-learning needed at each review.

Reed-funded continuing development– I won't leave home without it

- Cleaned-up – neatened, logically sectioned.
- Added instructions tab, notes and comments in cells.
- Added many statistical calculation modules to eliminate manual set-up and inputs.
- Added several calculational routines -- easier to answer common questions.
- However, more is needed.



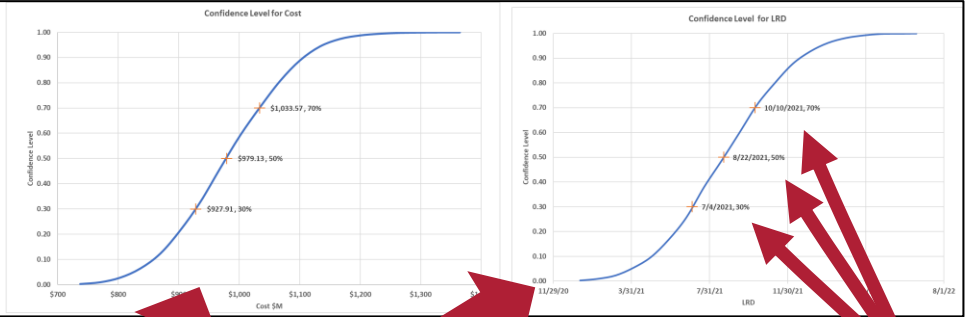
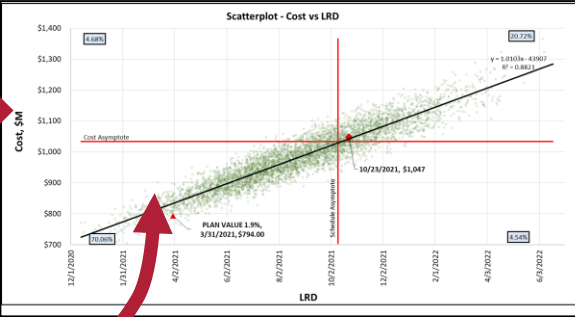
Question? Is there enough interest in a tool like this to warrant further investment?

Structure of Scatterplotter, Part 1 A Single Worksheet in Excel Workbook

Download from
Monte Carlo Tool

Scatterplotter
Input
Cost* Schedule

Scatterplot
Calculator
JCL Point
Cost CL
Sched CL
Asymptotes
Quartiles
Max/Mins



PDF and CDF Calculator

Cost Schedule

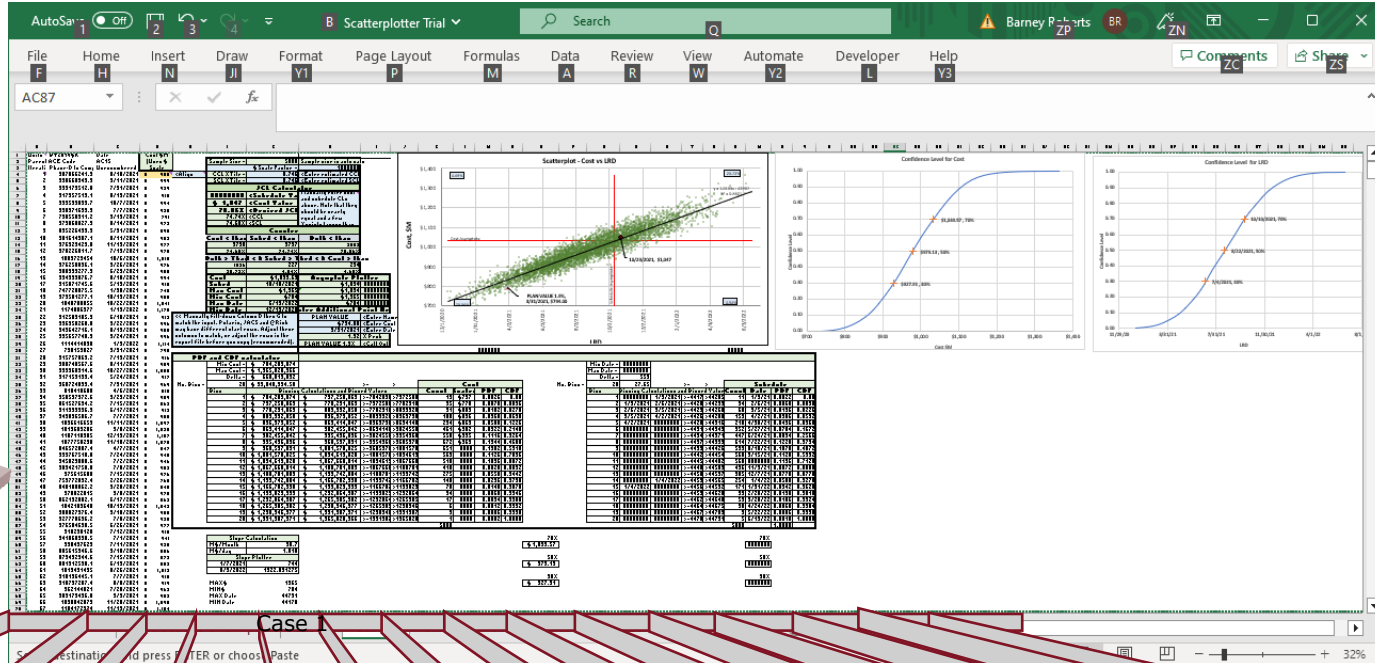
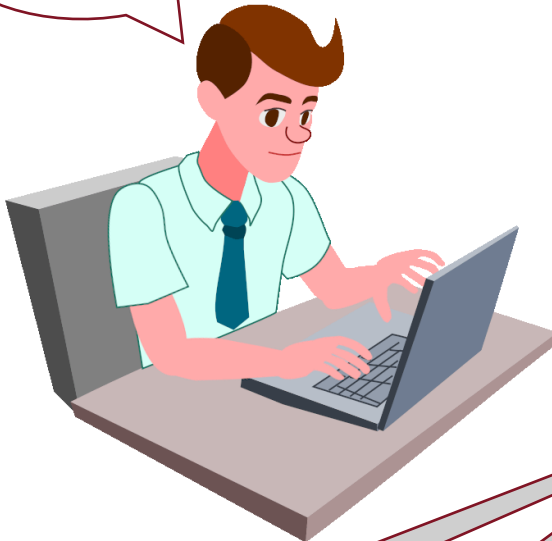
Slope Calculator
Slope Plotter
Scale for
Scatterplotter

CDF Points Calculator
Cost Schedule

* There is a scaler for cost, \$M, \$B, whatever

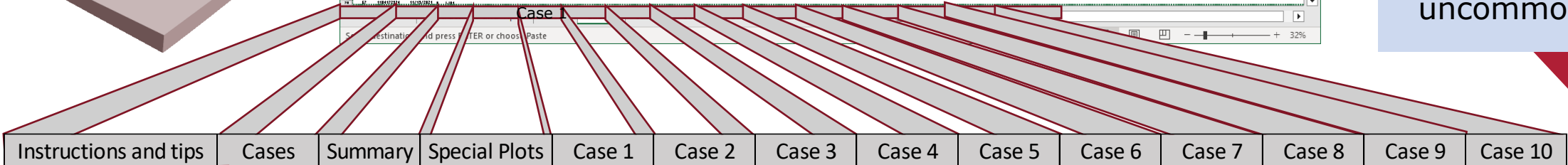
Structure of Scatterplotter, Part 2 The Workbook

Ahh, one click, all in one file.



Typical worksheet shown

For a major project, 20+ cases not uncommon



A listing of each case

Combined cases, multiple scatterplots

Whatever comes to mind

Case tabs: All results are in one file

Case Tab

- It can be whatever you want, but a few tips ...

Must correspond to the worksheet tabs

Titles must be same as used in chart legends

Whatever cooks your grits

These need to be file names so that one can find the original source, or repeat the analysis if necessary

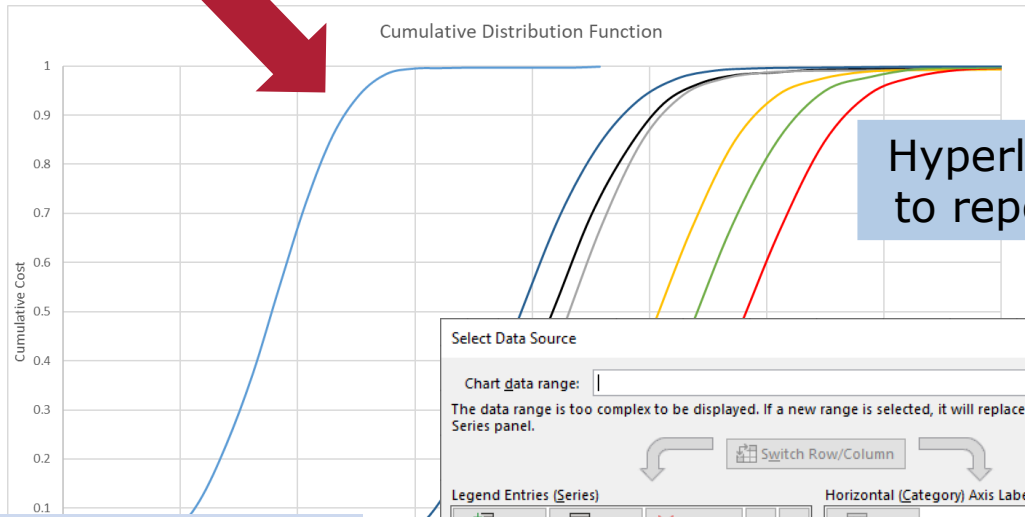
Case	Title	Description	Risks	Uncertainties	JCL Model File Name
Case 1	Case 1. Adjusted Gv't LOE	Made cost consistent with schedule in the JCL. Gv't LOE costs were for 20 months to launch JCL was for 17 months. Reduced costs by 17/20	SRB Baseline	SRB Baseline	JWST SIR2 - Baseline
Case 2	Adjusted Gv't LOE and NGAS LOE	Ditto case 1 but also reduced NGAS LOE by 323/383	SRB Baseline	SRB Baseline	JWST SIR2 - Baseline Adjusted Govt NGAS LOE
Case 3	Adjusted Schedule	Made JCL schedule consistent with total LOE costs. Added margin tasks back in and coed JACS to remove	SRB Baseline	SRB Baseline	JWST SIR2 - Baseline w-Margins Restored and Orig LOE Costs
Case 4	Case 3 w-NGAS Uncertainty Changed	Same as case 3 with NGAS LOE to launch cost uncertainties changed to 100,110,120 to accommodate expectation of increased NGAS costs.	SRB Baseline	SRB Baseline, except NGAS LOE to launch changed	JWST SIR2 JCL SRB BL w Margs Restored Orig LOE NGAS Uncer

Summary Tab

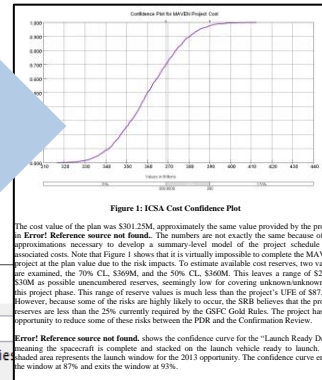
Plot all relevant cases from Case X tabs using "Select Data"

- As with the Case Tab, can be whatever you need; examples ...

Special scatterplots, e.g., for a Mars mission showing solutions within launch window



Hyperlink to report



Select Data Source

Chart data range: |

The data range is too complex to be displayed. If a new range is selected, it will replace all of the series in the Series panel.

Switch Row/Column

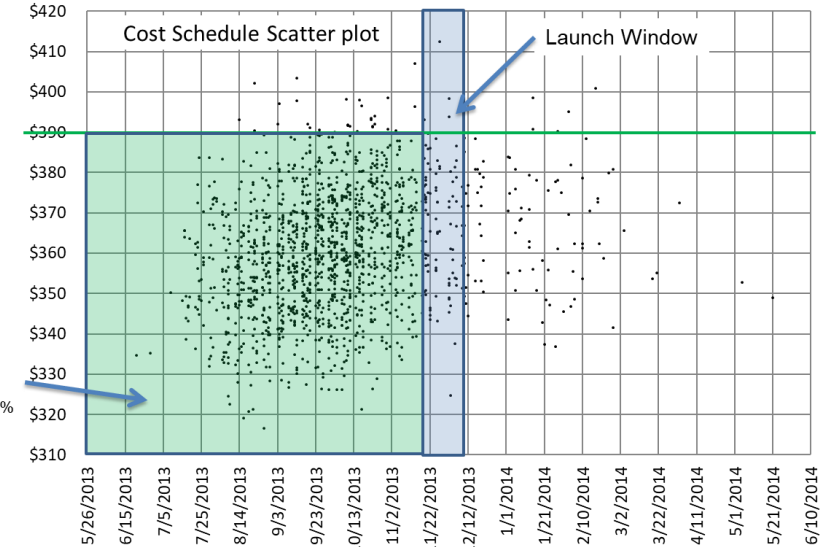
Legend Entries (Series)	Horizontal (Category) Axis Labels
<input checked="" type="checkbox"/> Program: P/P+T/B*1.1	\$10.63
<input checked="" type="checkbox"/> SRB Case 1: B*.95/B+T/B*1.1	\$10.74
<input checked="" type="checkbox"/> SRB Case 2: P+T/70%Int/B*1.1	\$10.85
<input checked="" type="checkbox"/> SRB Case 3: P+T/70%Int/B*1.2	\$10.97
<input checked="" type="checkbox"/> SRB Case 4: P+T/70%Int/BOE*1.3	\$11.08

Hidden and Empty Cells

OK Cancel

Use the Excel "Select Data" module to show specific comparisons as requested

Successful Solutions = 85%
To close of window = 91%



Add special "stuff", ABC, MA, Plan, Other independent assessments

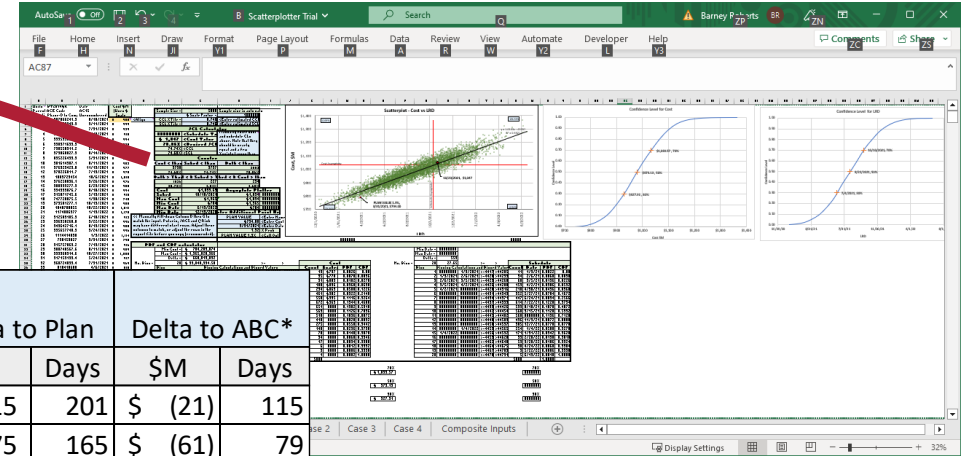
Special Plots Tab

- This is where you put the other things you might want, such as:

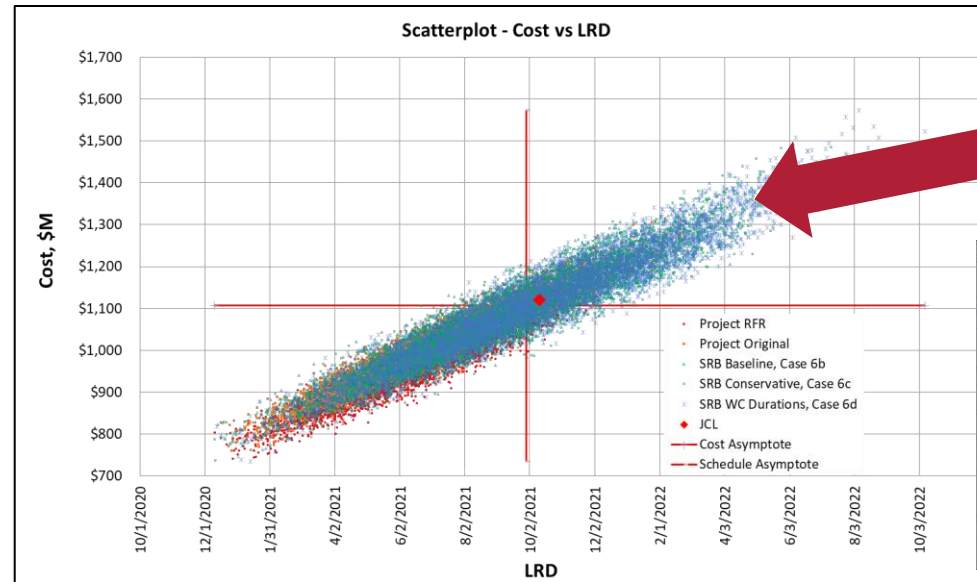
- JCL tables

	JCL Results		Plan		ABC*		Delta to Plan		Delta to ABC*	
	\$M	Date	\$M	Date	\$M	Date	\$M	Days	\$M	Days
Project RFR Baseline 70%	\$ 1,009	7/24/2021	\$ 794	1/4/2021	\$ 1,030	3/31/2021	\$ 215	201	\$ (21)	115
Project RFR Baseline 50%	\$ 969	6/18/2021					\$ 175	165	\$ (61)	79
SRB Baseline 70%	\$ 1,135	10/24/2021					\$ 341	293	\$ 105	207
SRB Baseline 50%	\$ 1,070	8/31/2021					\$ 276	239	\$ 40	153
SRB Conservative 70%	\$ 1,163	11/17/2021					\$ 369	317	\$ 133	231
SRB Conservative 50%	\$ 1,093	9/23/2021					\$ 299	262	\$ 63	176

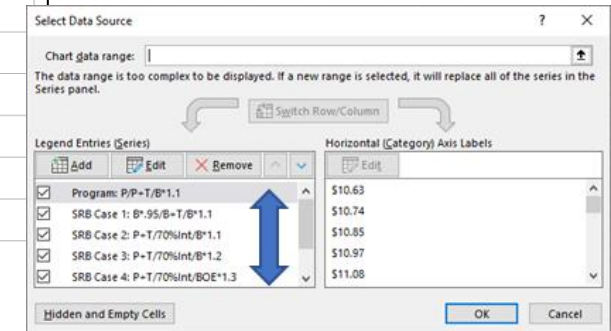
Linked from case tabs



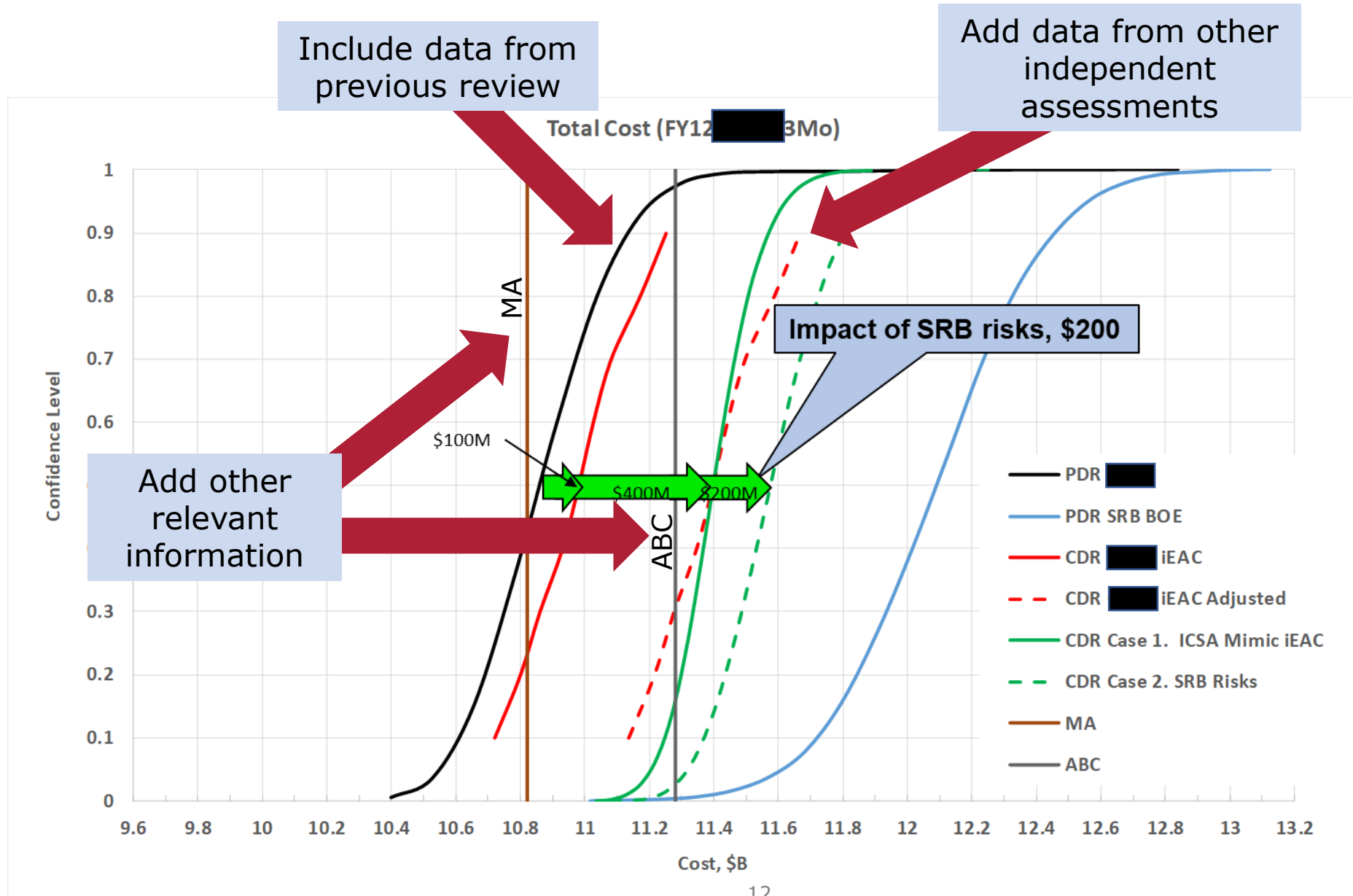
- Overlaid Scatterplots



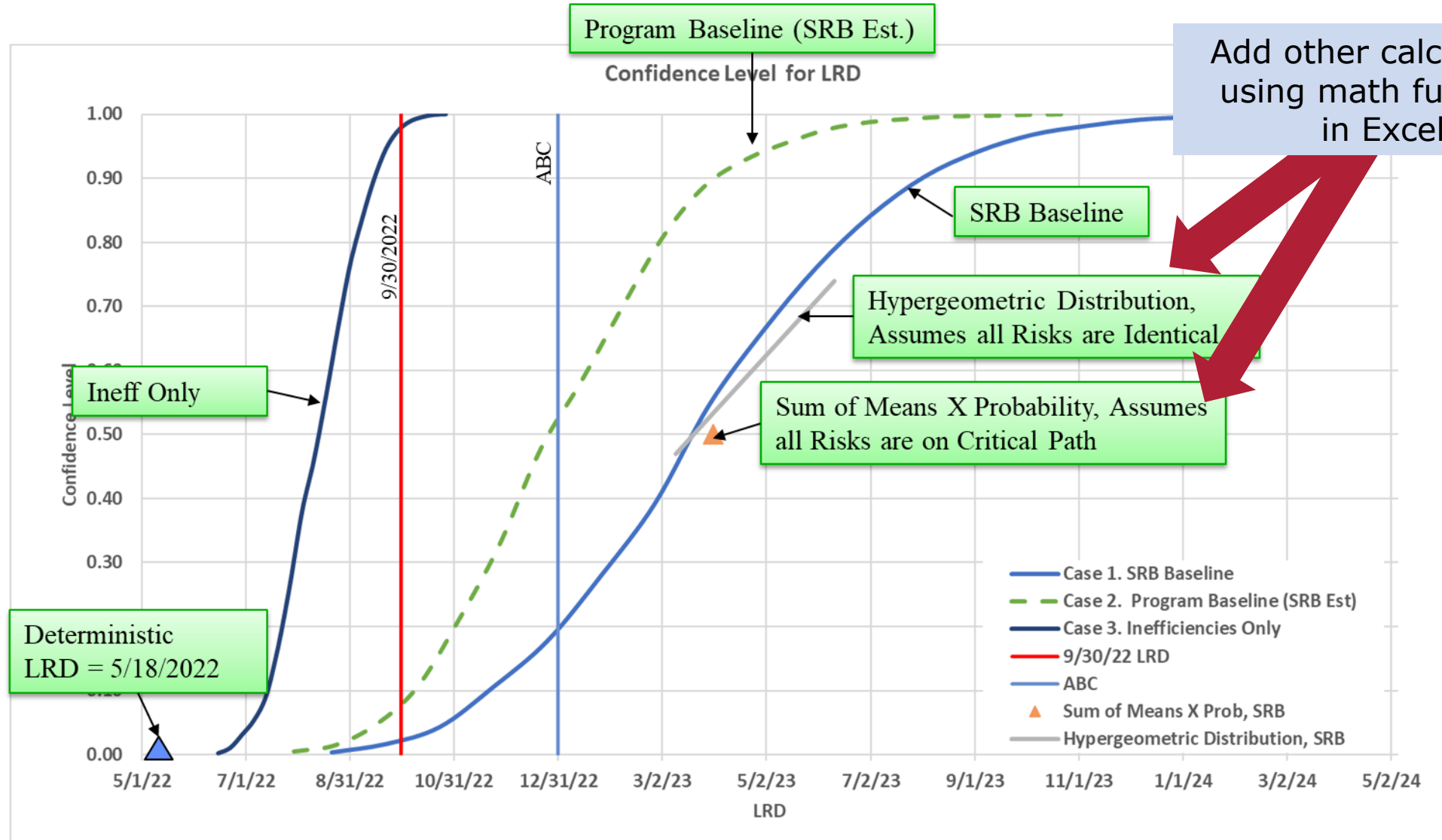
Use Excel "Select Data" to Move cases to the top/bottom



Special Plots Tab



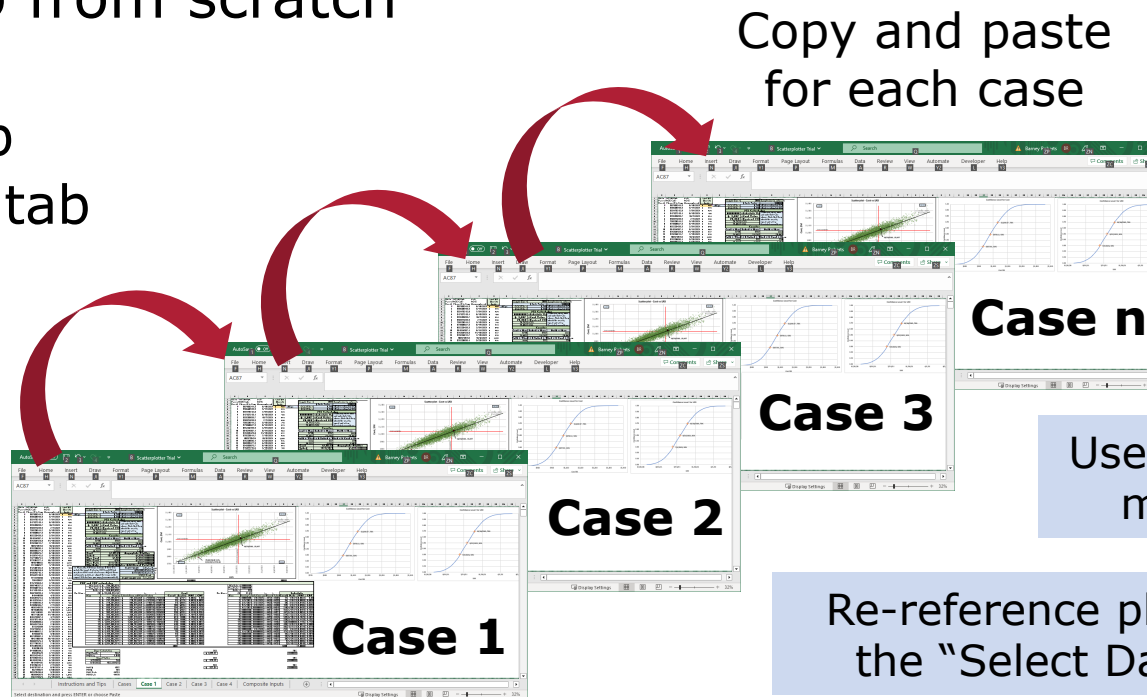
Special Plots Tab



Using Scatterplotter: Setup

- Easy-peasy: Use previous workbook from last review
 - Re-load Cases tab
 - Drop in new iteration data in the case tab as appropriate, likely to need to rescale plots
 - Re-work Summary tab and Special Plots tab (if needed)
- More tedious: Set-up from scratch
 - Set up Cases tab
 - Set up Summary tab
 - Set up Special Plots tab

Desired Improvement:
Macro button to copy, paste and re-reference




Use consistent names for tabs;
makes re-reference easier

Re-reference plots using
the "Select Data" tool

Using Scatterplotter: Loading

Monte Carlo Model
JACS, Polaris, @Risk

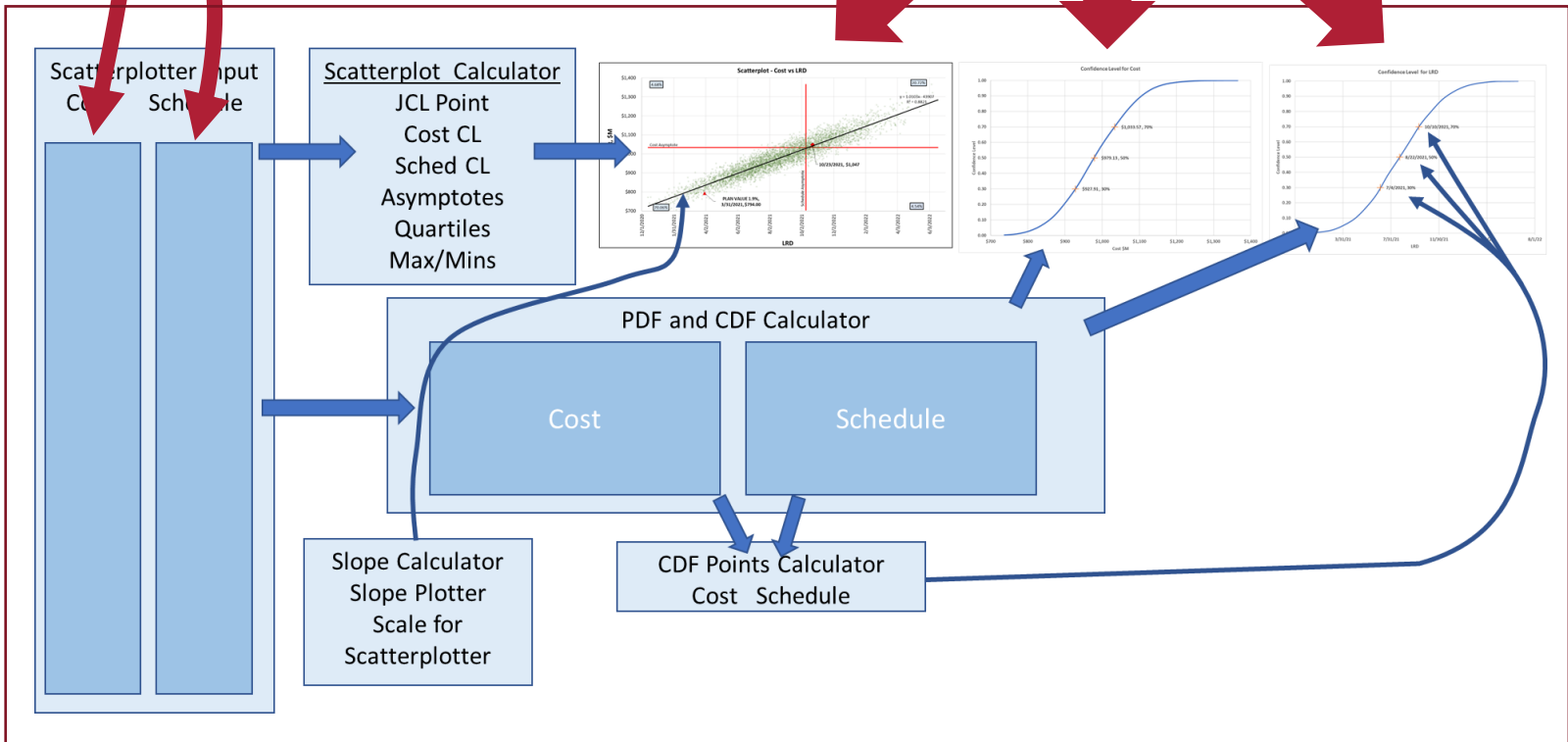
Risks Uncertainties



Desired Improvement:
Add MA and ABC to plots

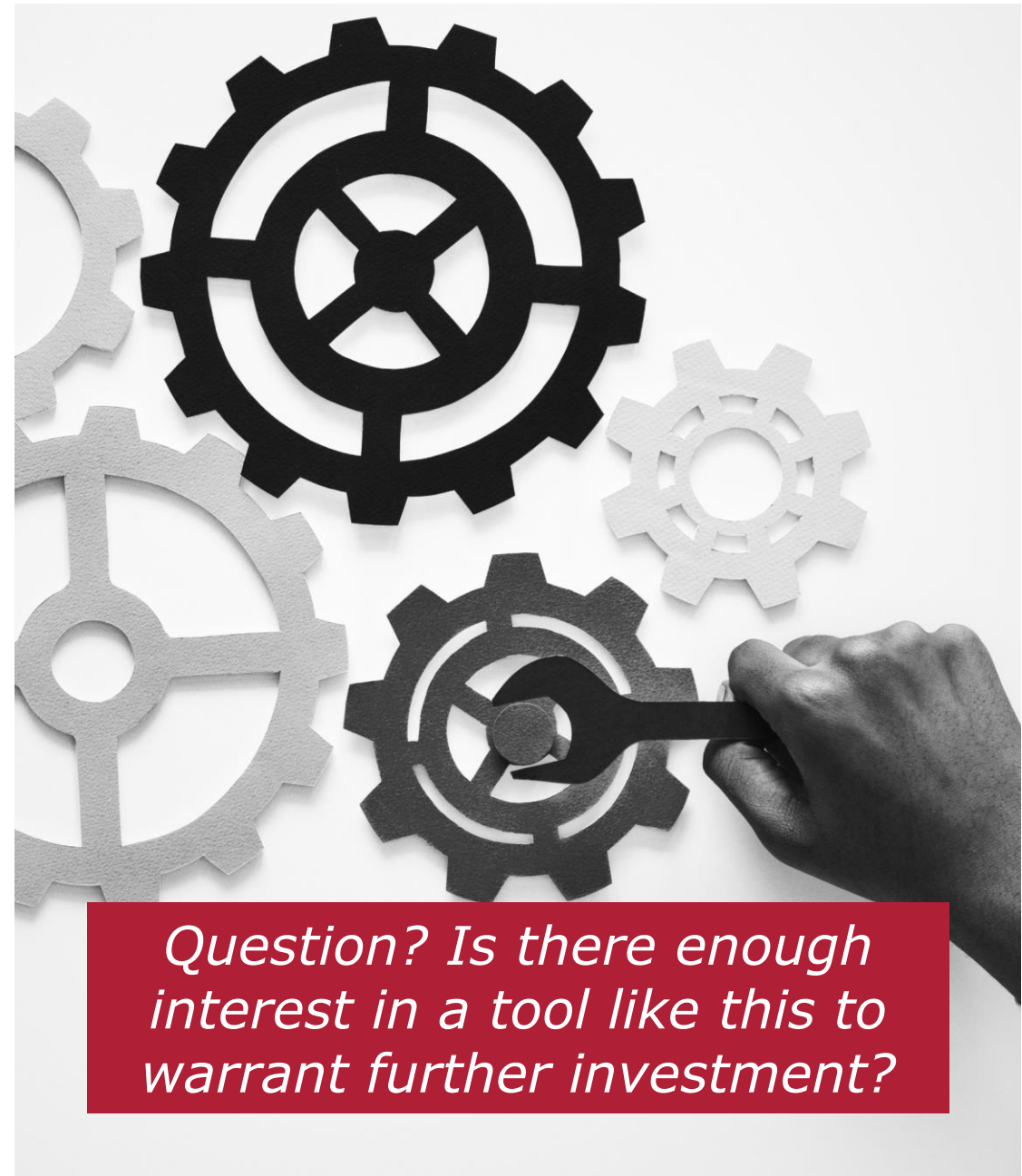
Data points of interest for each iteration
(Number of iterations not needed)

Re-scaling may be required



Get off the Stage Chart

- I won't go anywhere without it.
- Public version: Klutzy, needs automation, a lot of manual intervention.
- Reed-funded version: Streamlined, a lot of automation, notes and tips.
- More automation needed.
 1. "Copy Spreadsheet" macro: Automatically re-reference the plots (accuracy).
 2. Add more plot data.
 3. JCL frontier curve plotter.



Question? Is there enough interest in a tool like this to warrant further investment?

A Mars rover is positioned on a dark, rocky ridge in the foreground. The background features a vast, hazy landscape under a bright, orange and yellow sky, suggesting a sunset or sunrise on Mars. The word "Questions?" is written in large, white, sans-serif font on the right side of the image.

Questions?