Barcelona R

Collecting clean and usable data for better reliability modelling

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RELIABLE DYNAMICS

Agenda

- Who we are?
- Modeling 101 - Quick introduction
- So, what can we do?
- Six steps to improve any modeling
- Demo/Case
- Recap

Who we are?

We believe that **reliability engineering** practitioners should focus on delivering value and developing critical thinking in **O&M** environments. **Software should not be a barrier** to apply this techniques in any organization. We take care to eliminate that barrier.

We believe that the competitive advantage is to have **a wide range of apps**, that increase the reliability inside any organization, regardless of **size and budget**.

We develop **basic applications** with **modern technologies**. Trough standard applications or custom solutions. Our products include apps from statistical calculations, reporting, to warranty predictions and predictive maintenance.

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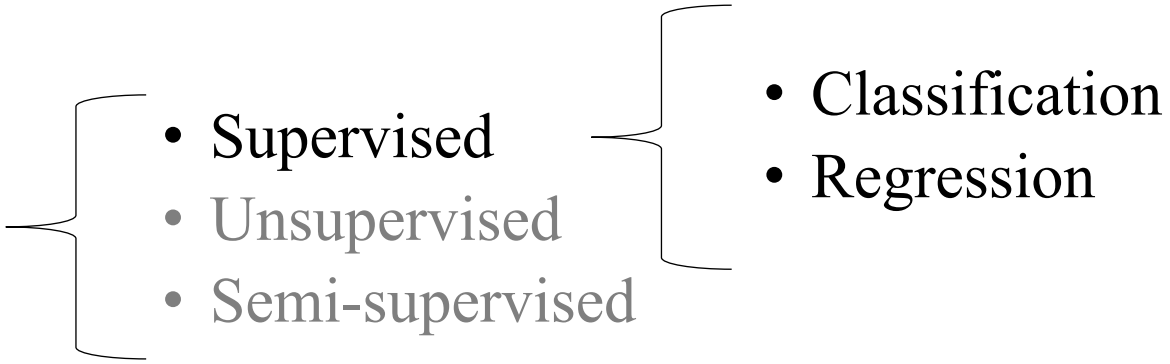
Modeling 101

- Reliability modeling
  - Life data analysis (statistical)
  - Vibration (deterministic)
  - Oil sampling

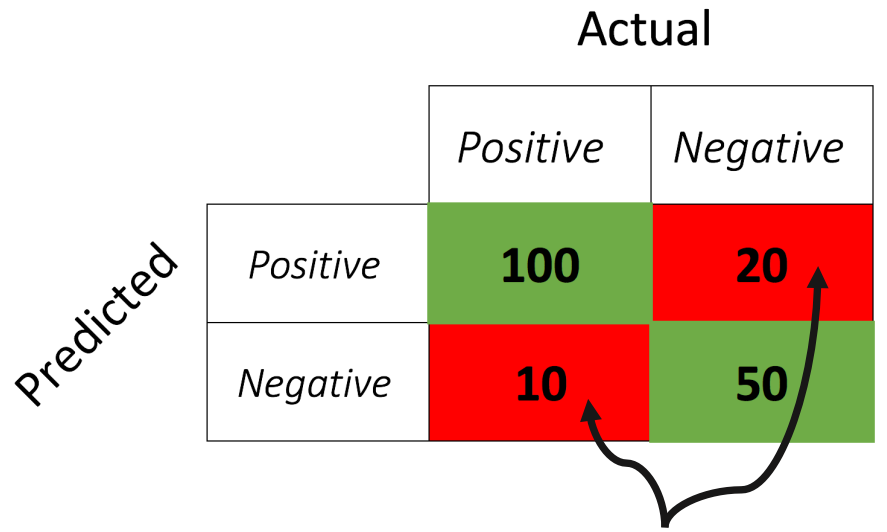
Output = function (Input)

- Algorithms
  - Machine learning
  - Deep learning
  - Reinforced learning



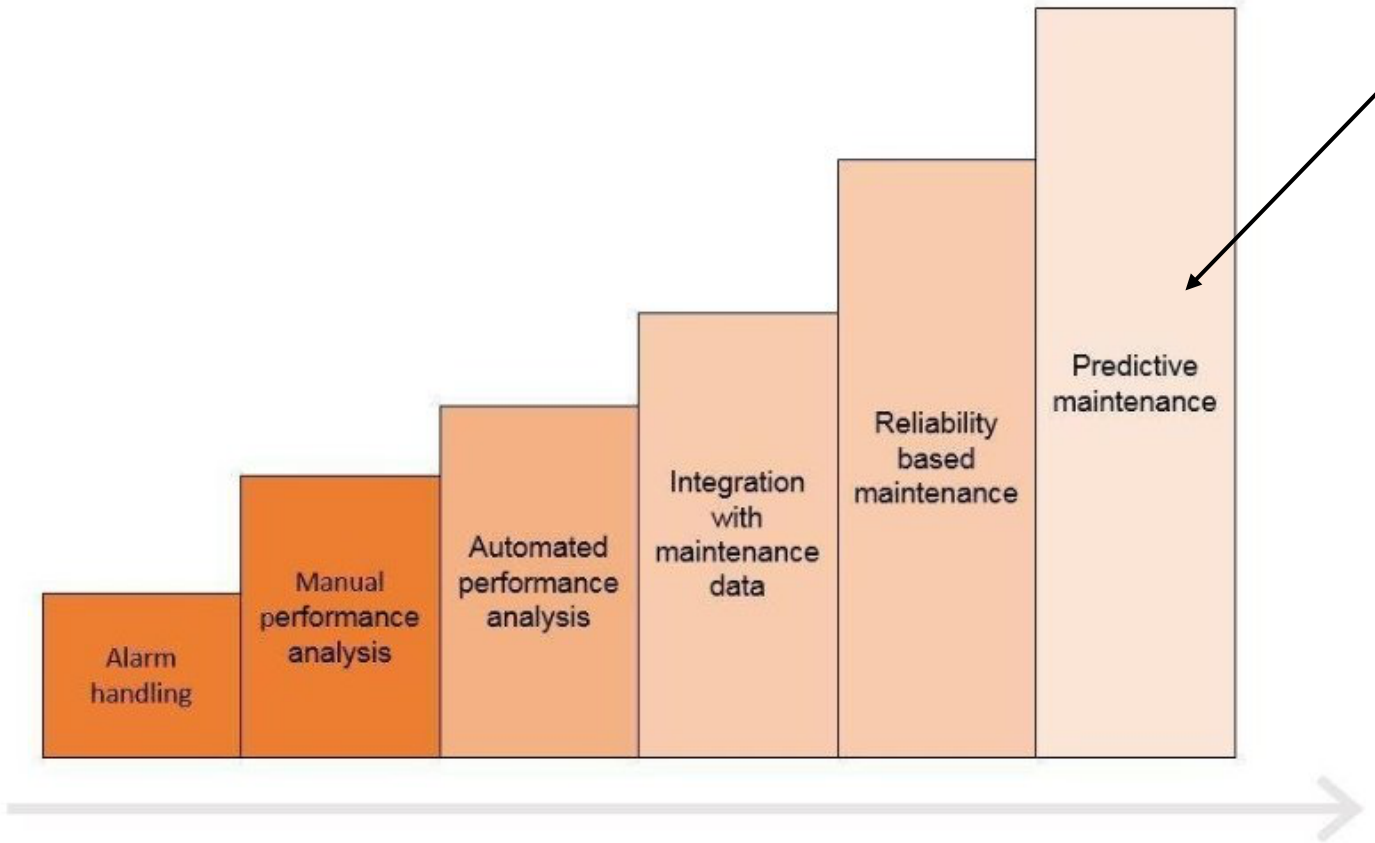
Modeling 101

- Data driven services require integrated workflows
- Garbage in / garbage out
- No free lunch theorem
- Confusion Matrix



Keep track of miss-detection!

Modeling in Operation & Maintenance



Lot's of opportunities!!

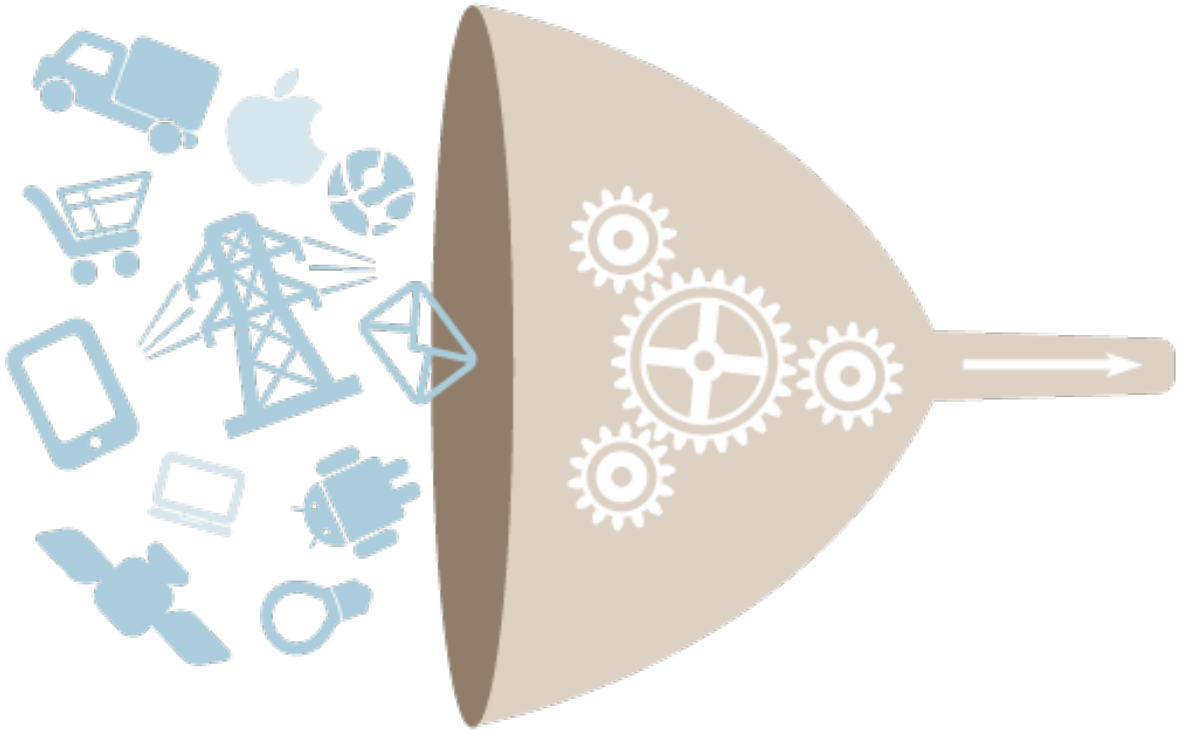
BUT need clear data strategy collection!

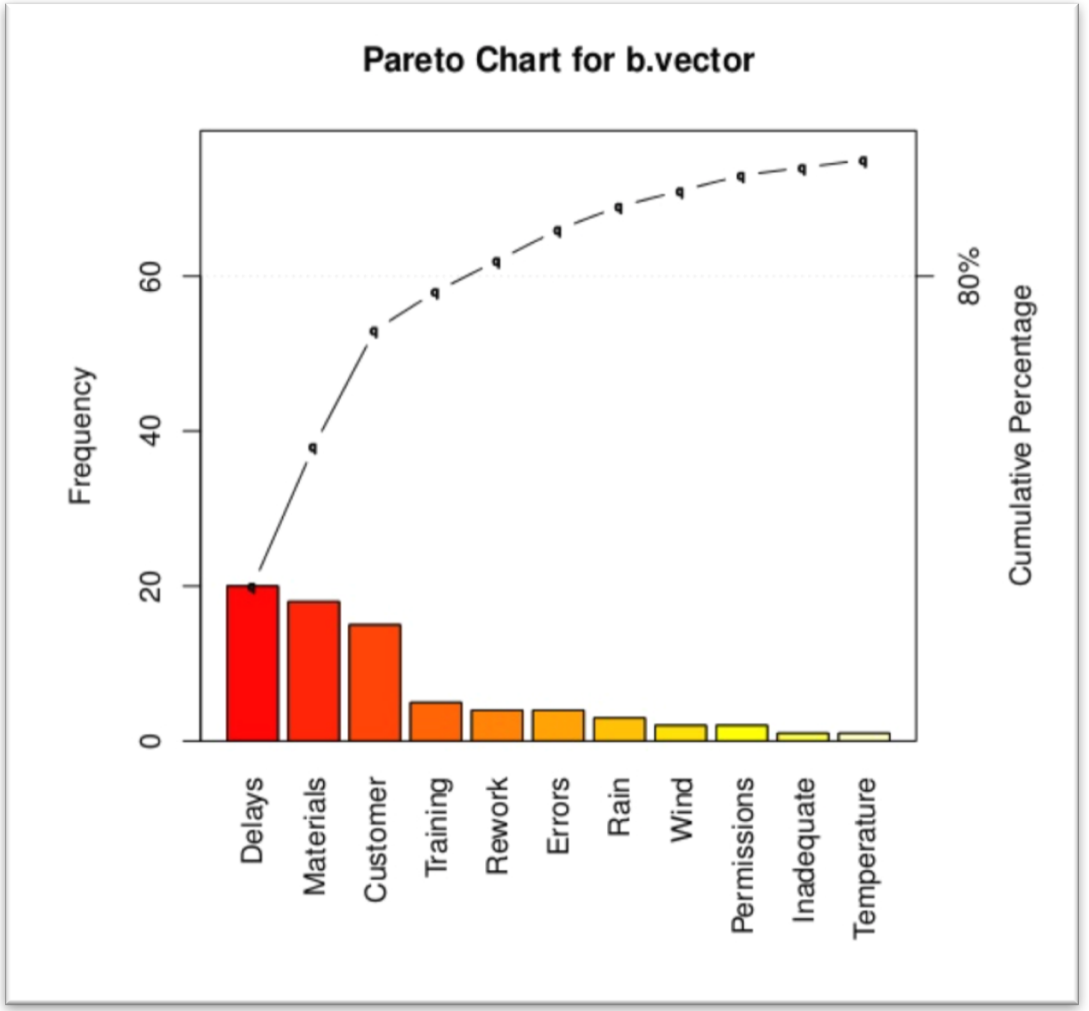
So what can we do??

> "By sharing their algorithms, Facebook and Google are merely sharing the recipe. Someone has to provide the eggs and flour and provide the baking facilities (which in Google and Facebook's case are vast data-computation facilities, often located near hydroelectric power stations for cheaper electricity)."
>
> The Guardian.

> "This is probably why Facebook and Google have so freely shared their methodologies: they know that the real value in their companies is the vast quantities of data they retain about each one of us."
>
> The Guardian.

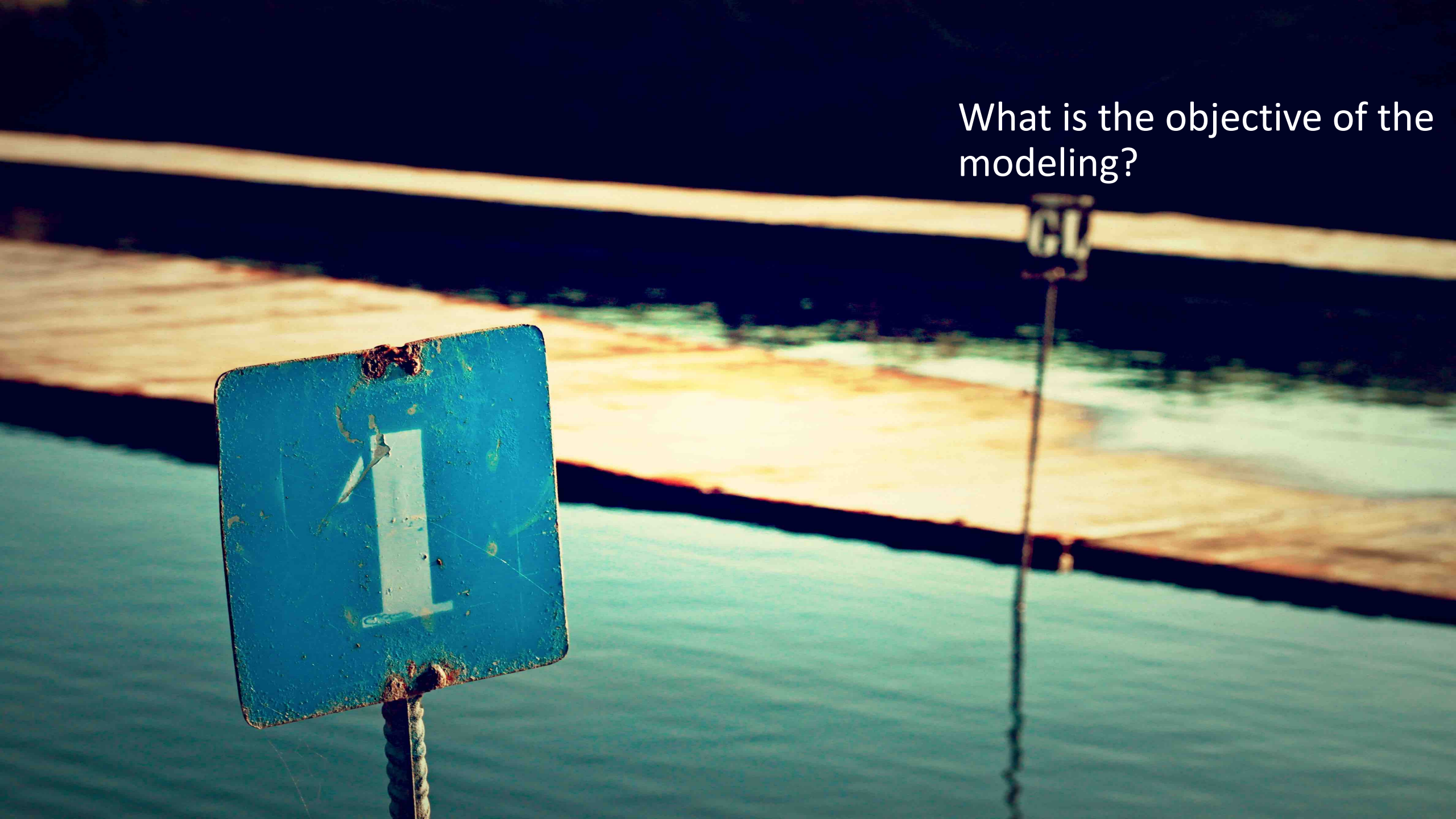
Data Centric





Six steps to improve your modeling

Photo by Clem Onojeghuo

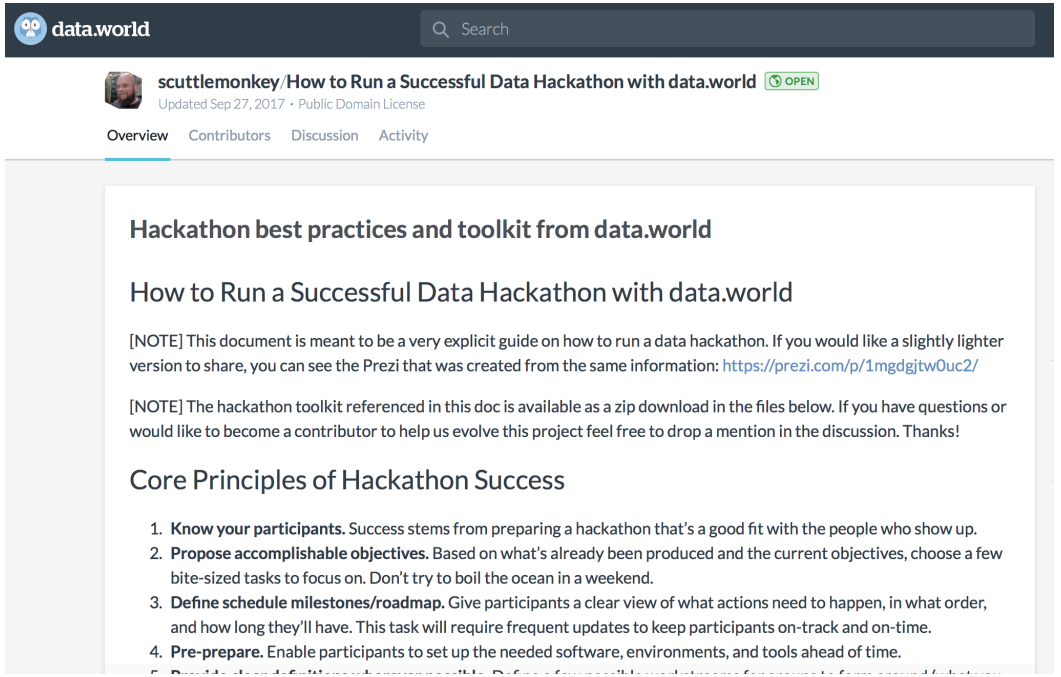

What is the objective of the modeling?


What is the ideal data set?

Step 2 – Ideal data set

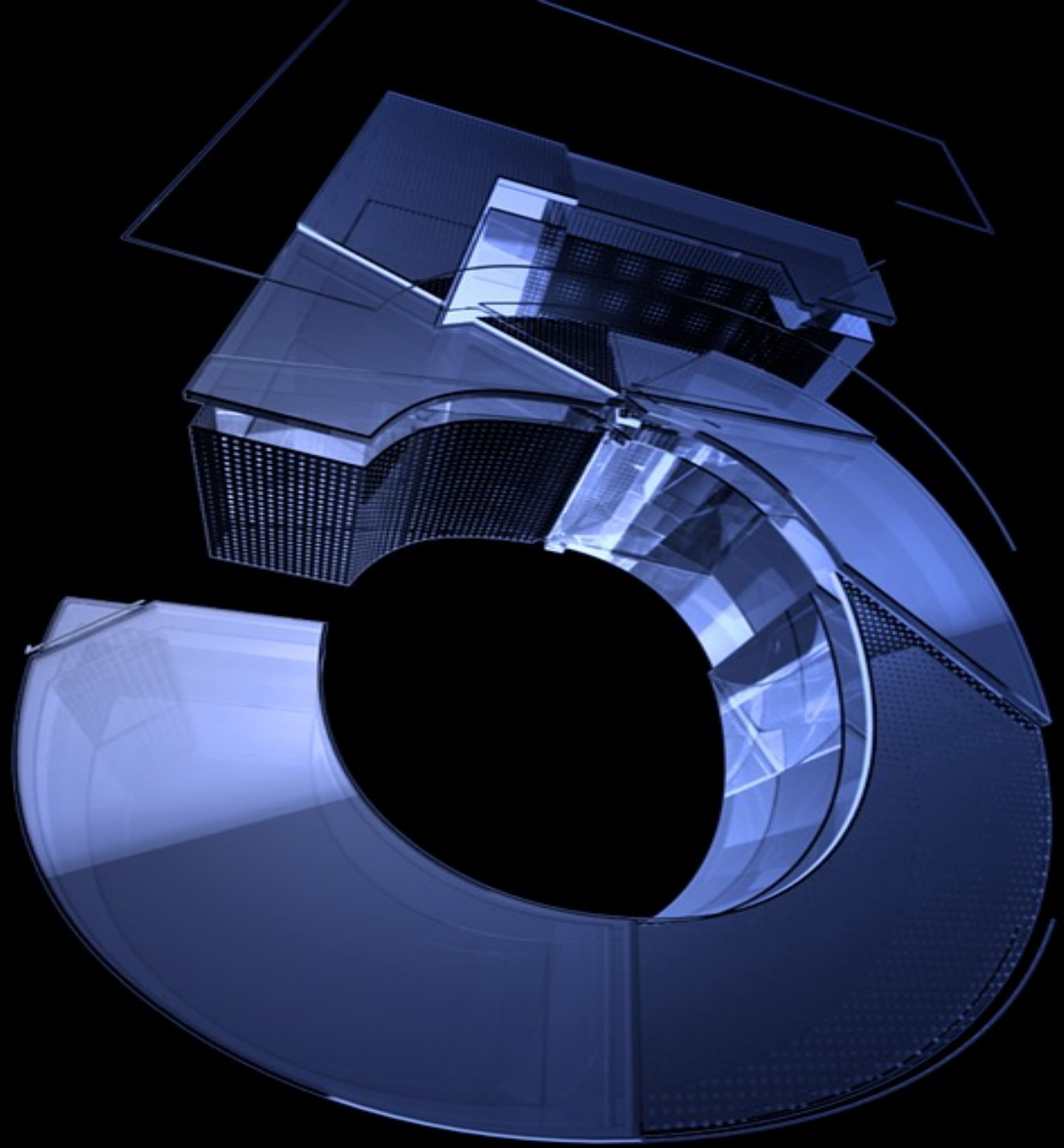
Cluster	Parameter
Time	Age of component
	Time
Stress	Full load hours
	Shear modus
	Deviations
Environment	AMB temperature
	Wind speed
	Wave height
	Wake effect
Maintenance	Crane/non-crane components
	Rate/degree/effort of maintenance
	Human factor

Guide Data sharing by Jeff Leek



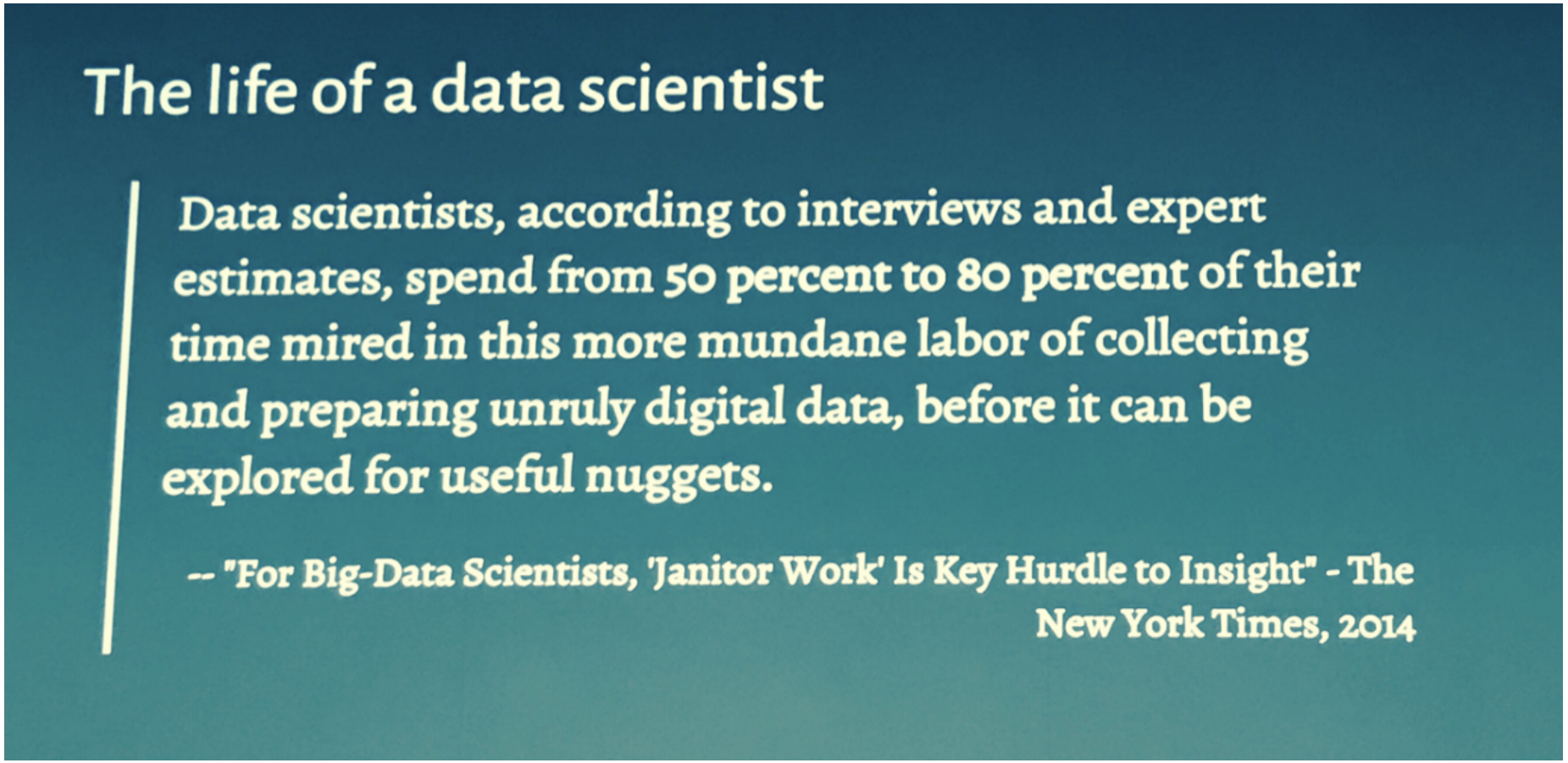
Is there domain expertise available?


What data is
available?



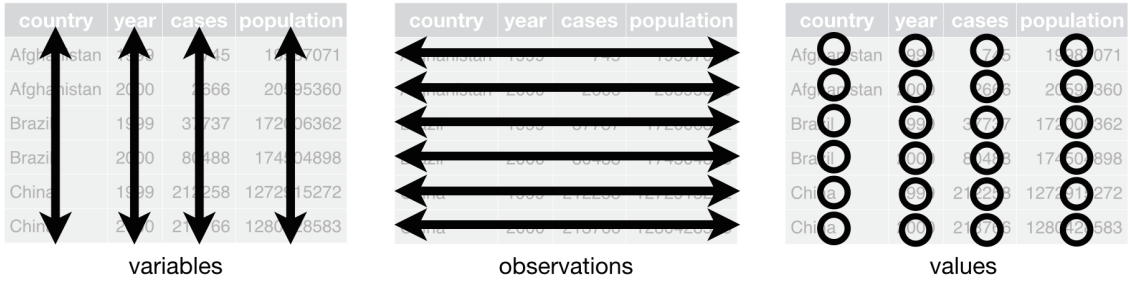
Is the data clean & usable?

Step 5 – Data cleaning



Step 5 – Data cleaning

- Guides
  - Data sharing by Jeff Leek
  - The Quartz guide to bad data
  - Reliability Centered Maintenance – Asset data register

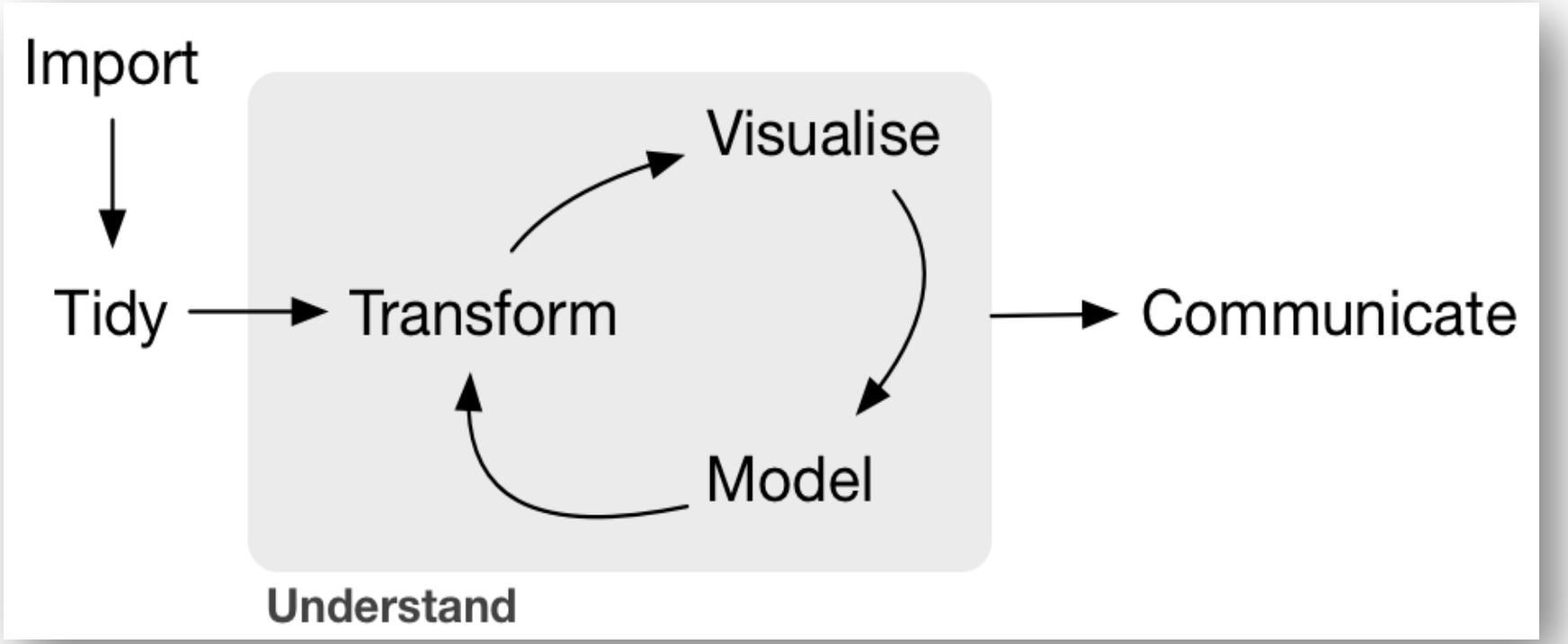


- Data steward
- Is it tidy data?
  - Transactional data
  - SCADA data
  - Failure data (time, energy)

1. Each variable in the data set is placed in its own column
2. Each observation is placed in its own row
3. Each value is placed in its own cell


Photo by Austris Augusts
1
2
3
4
5
6
Discovery Loop

Step 6 – Discovery loop



by Hadley Wickham


www.makeaweibull.com
Demo
#makeaweibull

Main Takeaways

- There is a process!
  - Step 1 – Define objective of the modeling
  - Step 2 – Define ideal data set
  - Step 3 – Add domain expert (iterate step 1 & 2)
  - Step 4 – Document available data
  - Step 5 – Clean data & make usable
  - Step 6 – Discovery loop

- Base models go a long way!

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bit.ly/BarcelonaR

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Thank you!
Q&A

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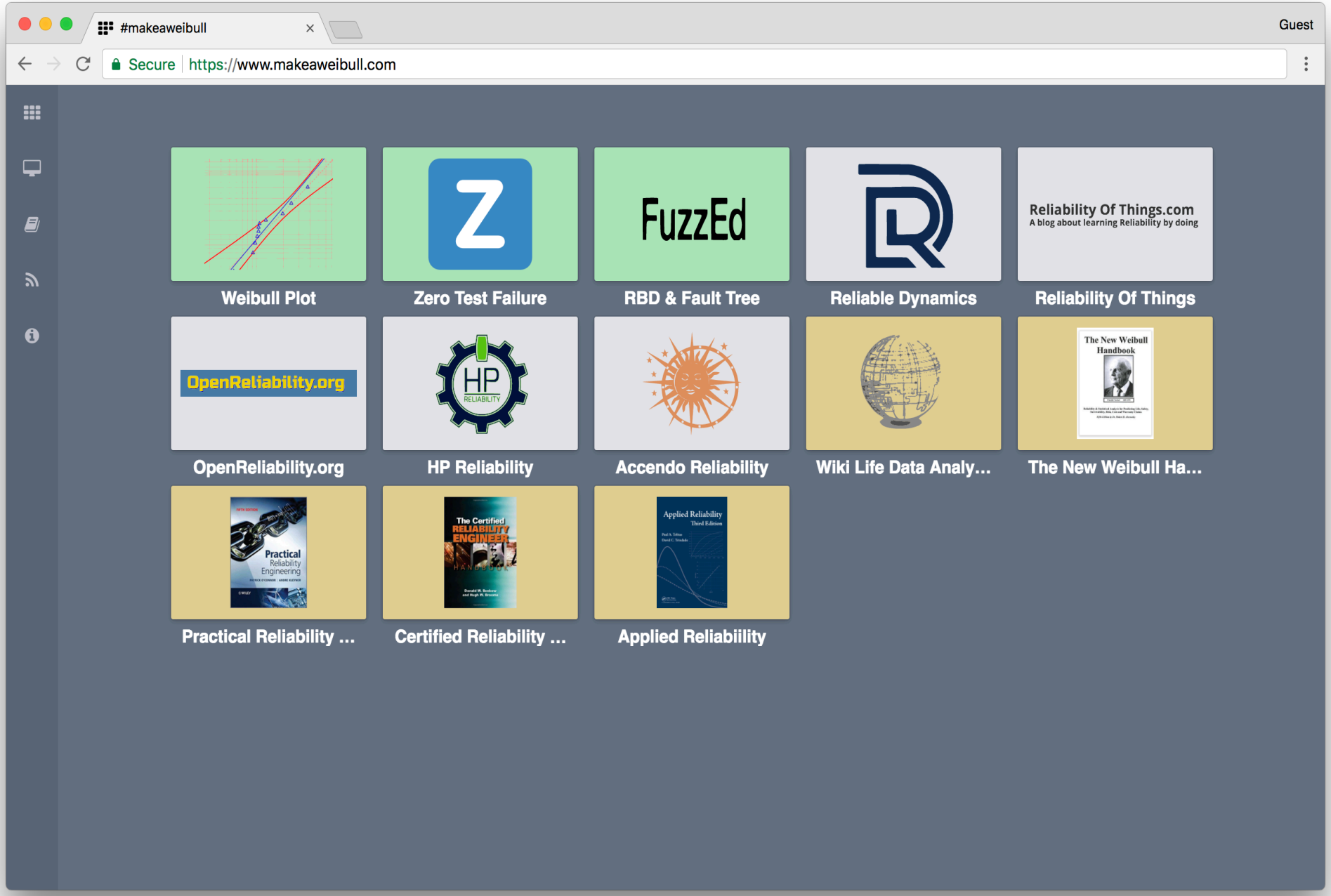
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Guest
Secure
https://www.makeaweibull.com
Weibull Plot
Zero Test Failure
FuzzEd
RBD & Fault Tree
Reliable Dynamics
Reliability Of Things.com
A blog about learning Reliability by doing
Reliability Of Things
OpenReliability.org
OpenReliability.org
HP
RELIABILITY
HP Reliability
Accendo Reliability
Wiki Life Data Analy...
The New Weibull Handbook
The New Weibull Ha...
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Engineering
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The Certified
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Certified Reliability ...
Applied Reliability
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Applied Reliabiility

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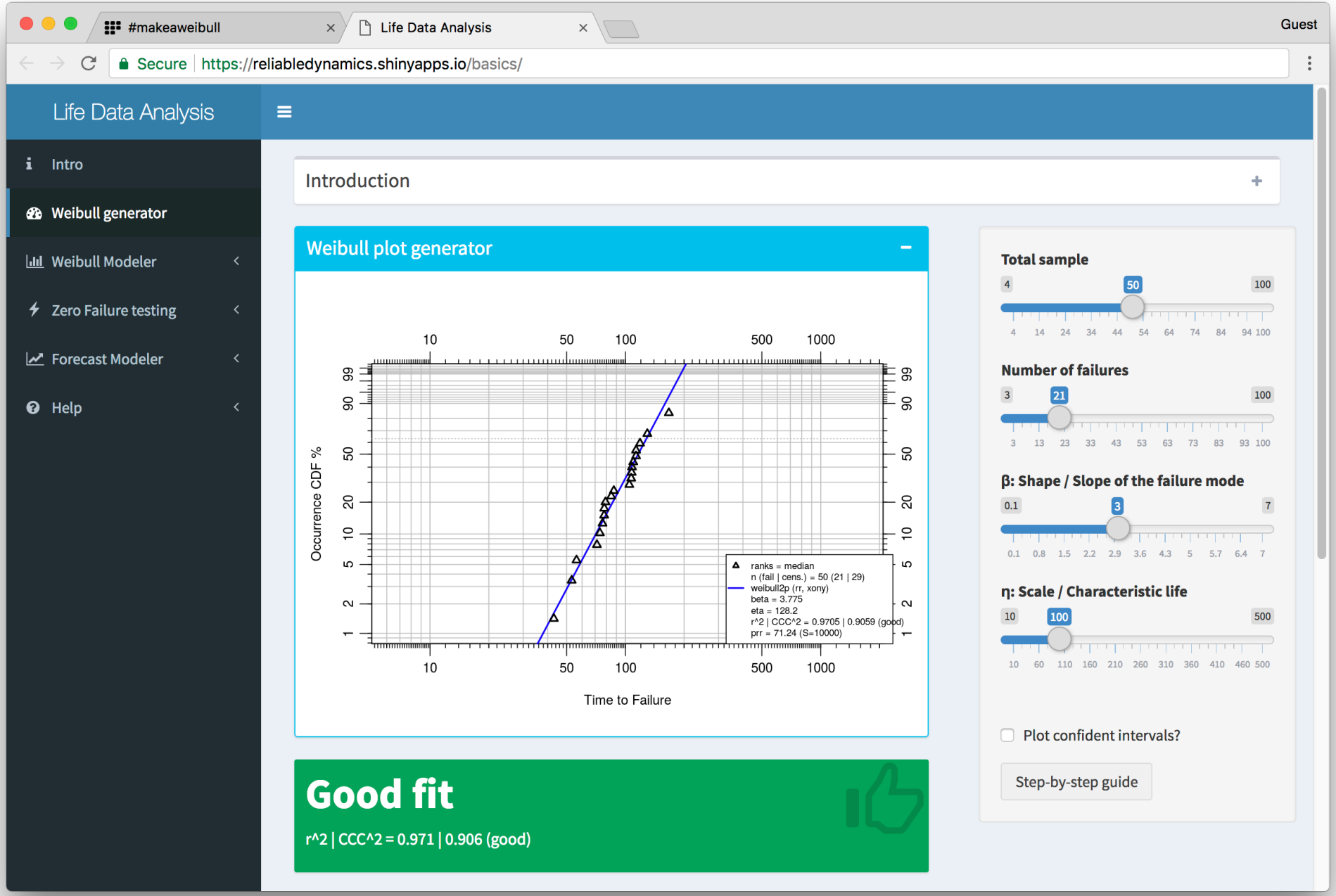

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BarcelonaR #1

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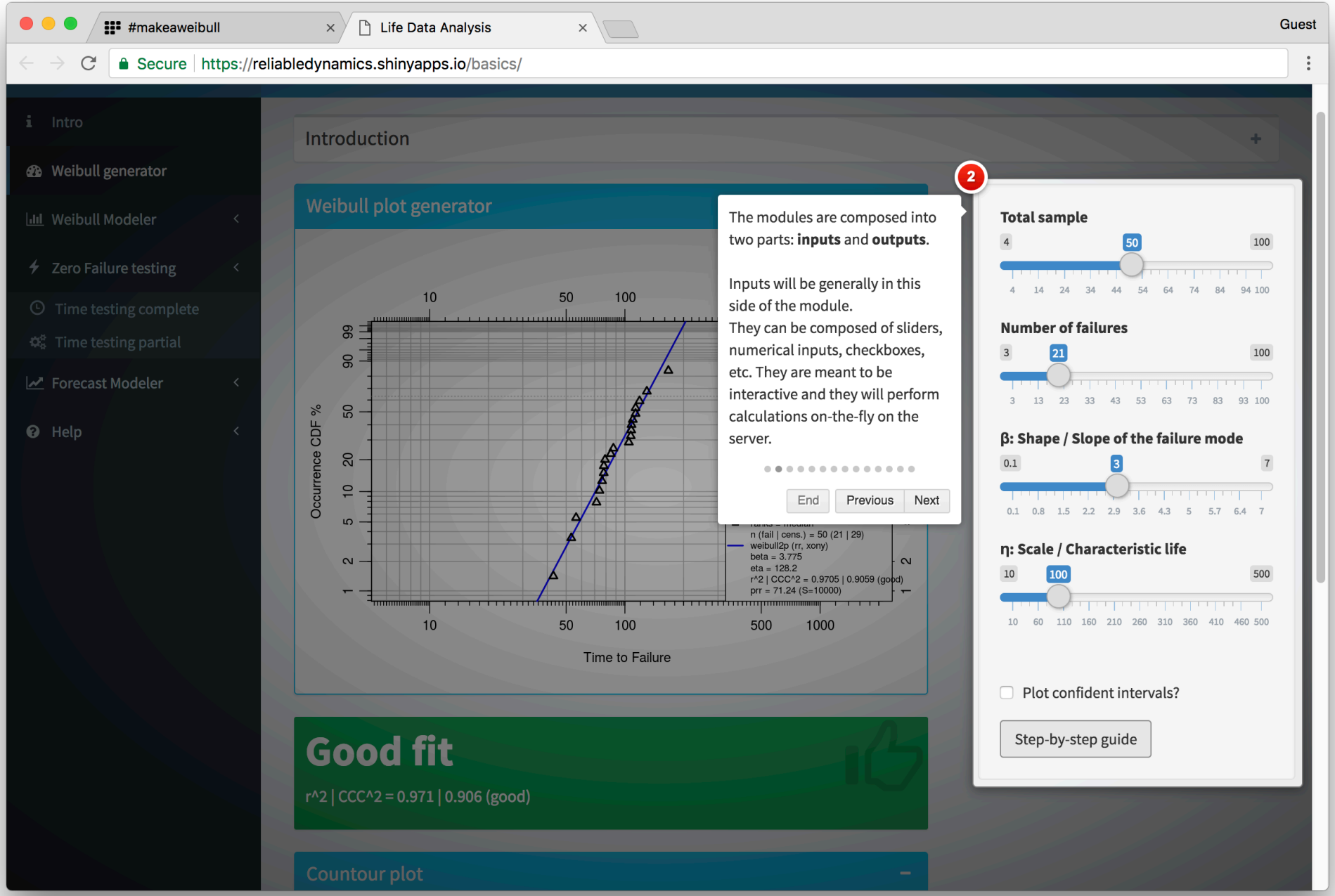
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Life Data Analysis
Guest
Secure https://reliabledynamics.shinyapps.io/basics/
Intro
Weibull generator
Weibull Modeler
Zero Failure testing
Time testing complete
Time testing partial
Forecast Modeler
Help
Introduction
Weibull plot generator
Occurrence CDF %
Time to Failure
n (fail | cens.) = 50 (21 | 29)
weibull2p (rr, xony)
beta = 3.775
eta = 128.2
r^2 | CCC^2 = 0.9705 | 0.9059 (good)
prr = 71.24 (S=10000)
The modules are composed into two parts: inputs and outputs.
Inputs will be generally in this side of the module.
They can be composed of sliders, numerical inputs, checkboxes, etc. They are meant to be interactive and they will perform calculations on-the-fly on the server.
End
Previous
Next
2
Total sample
Number of failures
β: Shape / Slope of the failure mode
η: Scale / Characteristic life
Plot confident intervals?
Step-by-step guide
Good fit
r^2 | CCC^2 = 0.971 | 0.906 (good)
Countour plot

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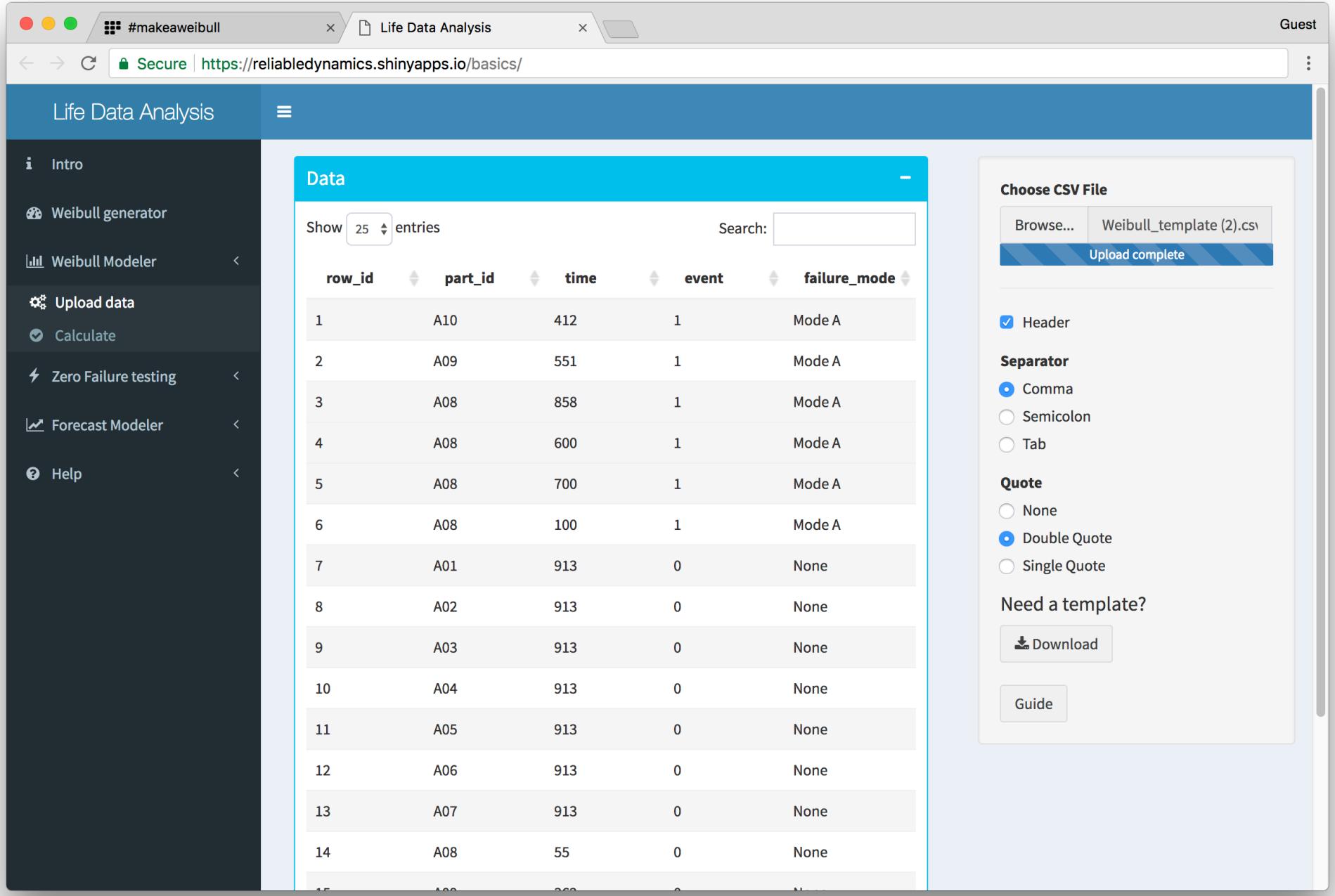
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Life Data Analysis
Intro
Weibull generator
Weibull Modeler
Upload data
Calculate
Zero Failure testing
Forecast Modeler
Help
Data
Show 25 entries
Search:
row_id part_id time event failure_mode
1 A10 412 1 Mode A
2 A09 551 1 Mode A
3 A08 858 1 Mode A
4 A08 600 1 Mode A
5 A08 700 1 Mode A
6 A08 100 1 Mode A
7 A01 913 0 None
8 A02 913 0 None
9 A03 913 0 None
10 A04 913 0 None
11 A05 913 0 None
12 A06 913 0 None
13 A07 913 0 None
14 A08 55 0 None
Choose CSV File
Browse...
Weibull_template (2).csv
Upload complete
Header
Separator
Comma
Semicolon
Tab
Quote
None
Double Quote
Single Quote
Need a template?
Download
Guide

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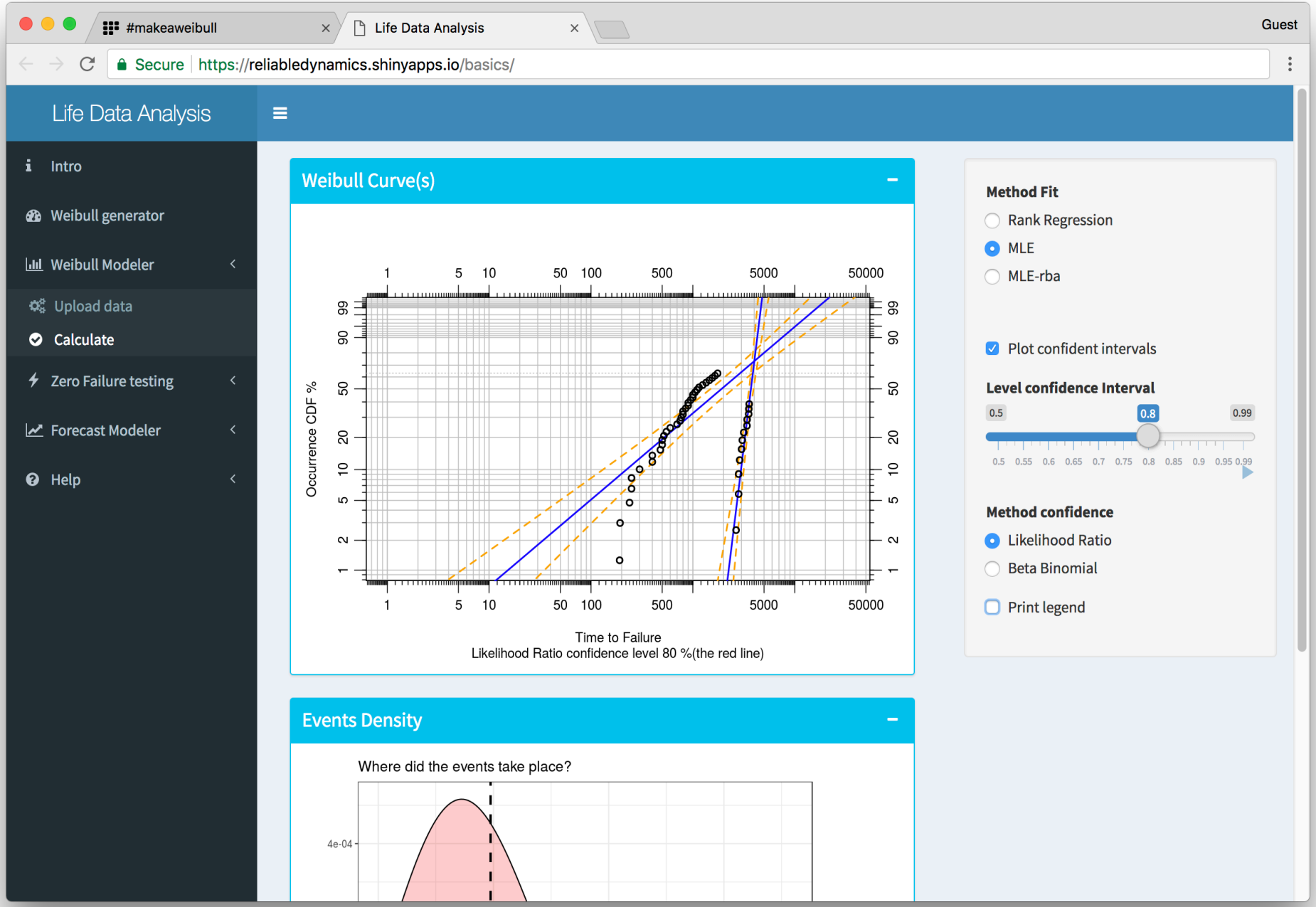
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Help
Weibull Curve(s)
Occurrence CDF %
Time to Failure
Likelihood Ratio confidence level 80 %(the red line)
Method Fit
Rank Regression
MLE
MLE-rba
Plot confident intervals
Level confidence Interval
Method confidence
Likelihood Ratio
Beta Binomial
Print legend
Events Density
Where did the events take place?

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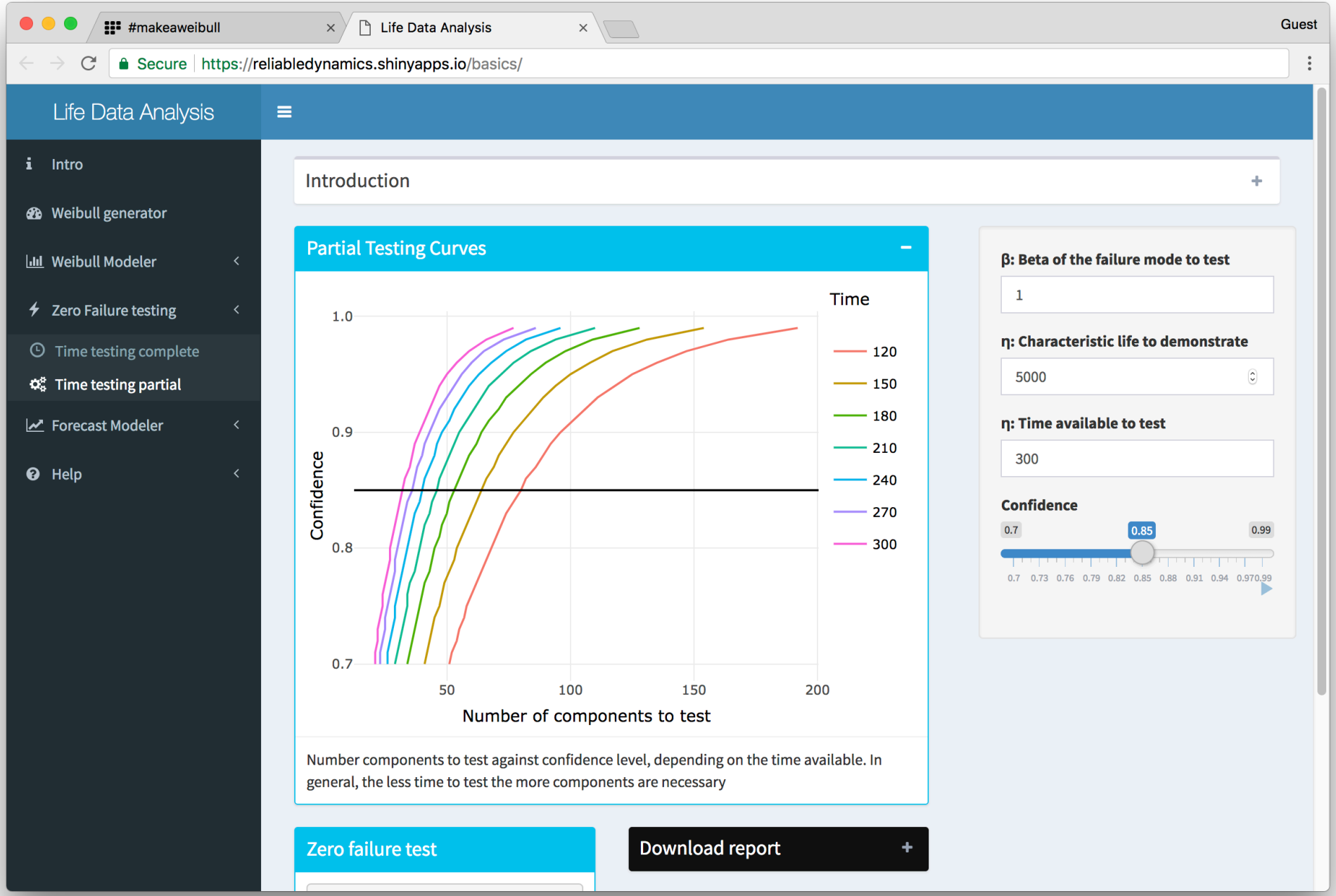
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Time testing complete
Time testing partial
Forecast Modeler
Help
Introduction
Partial Testing Curves
Time
120
150
180
210
240
270
300
1.0
0.9
0.8
0.7
Confidence
50
100
150
200
Number of components to test
Number components to test against confidence level, depending on the time available. In general, the less time to test the more components are necessary
β: Beta of the failure mode to test
1
η: Characteristic life to demonstrate
5000
η: Time available to test
300
Confidence
0.7
0.85
0.99
0.7 0.73 0.76 0.79 0.82 0.85 0.88 0.91 0.94 0.97 0.99
Zero failure test
Download report

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Demo End