Observability Data Engineering: The Search for π

A Story About Math, Four Golden Signals, and Business Intelligence

Jack Neely
jjneely@gmail.com

June 17, 2023

DevOps Observability Architect

> *What do I monitor?*

Google SRE's ~~Four~~ Five Golden Signals

Traffic Counter of Units of Work

Errors Counter of Units of Work with Exceptions

Latency Timer of the distribution of latencies for each Unit of Work

Saturation When Pods be scaled up or down

Health Is the thing up? Does it respond to customers?

As a DevOps Observability Architect...

The ~~Four~~ Five Golden Signals is knowing before the customers do.

> *We need to set alerts for these super special customers.*

Well, if we set our Histograms correctly and record maximum values we will be able to tell when...

> *When a customer calls we need to be able to verify the error they encountered. We'll need a high cardinally solution.*

Umm...those aren't metrics. Where are your traces?

> *Jack, we're an Enterprise!*

starship goes here

Traffic

How to count things

Why Counters Work

> *Systems based in cumulative monotonic sums are naturally simpler, in terms of the cost of adding reliability. When collection fails intermittently, gaps in the data are naturally averaged from cumulative measurements.*
> *– OpenTelemetry Data Model*

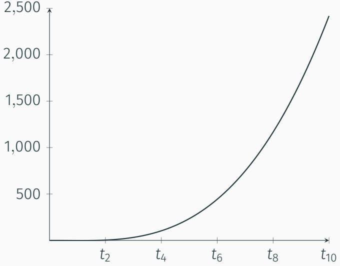
Most Accurate: Incremented in discrete whole numbers. Never misses an event.

Synchronization Primitive: Allows for multiple observers.

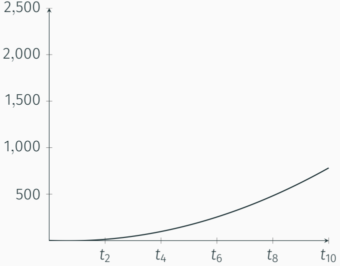
Low Overhead: Easy implementation. No copying or recalling previous values.

Fundamental: **Position!**

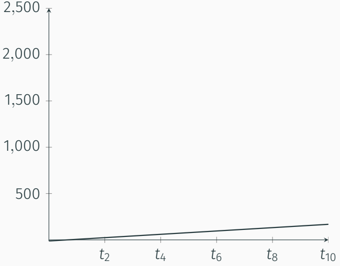
Position



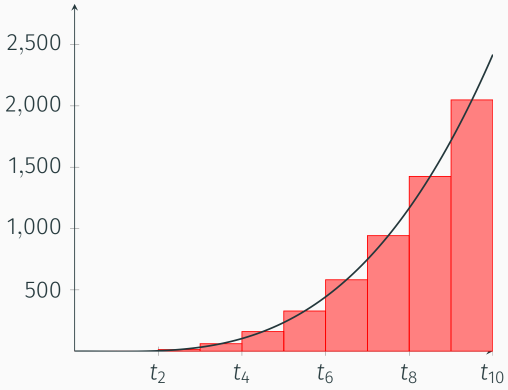
Velocity



Acceleration



Counting Caveats: Riemann Sums




```
interval: 5m
rules:
- record: labels:http_server_requests:rate5m
  expr: >
    sum by (service, namespace, status) (
      rate(http_server_requests_seconds_count{}[5m])
    )
```

Integrate and Build Ratio:

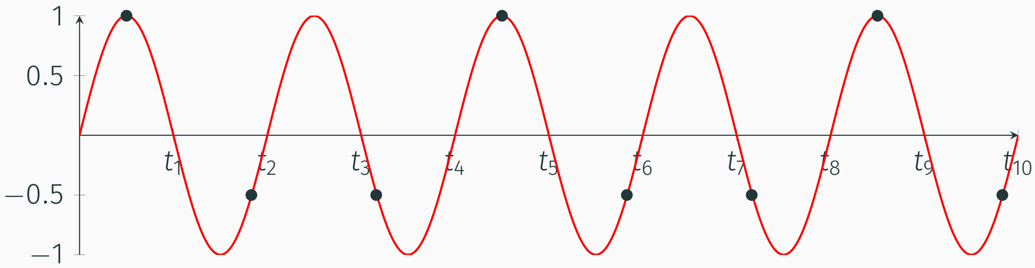
```
1 - (
  sum_over_time(
    sum without (status) (
      labels:http_server_requests:rate5m{
        status=~"5..", service="..."})[7d:5m]
  ) * 300 /
  sum_over_time(
    sum without (status) (
      labels:http_server_requests:rate5m{
        service="..."})[7d:5m]
  ) * 300
)
```

Errors

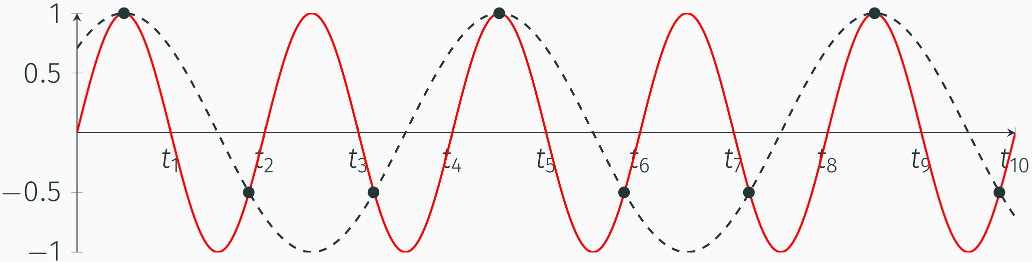
Measuring CPU Usage Over Time

How do you measure CPU usage of a process?

a. Jiffies
b. Percentages
c. Seconds a Process is in the Running State
d. All of the above



$$ScrapeInterval > 2f$$

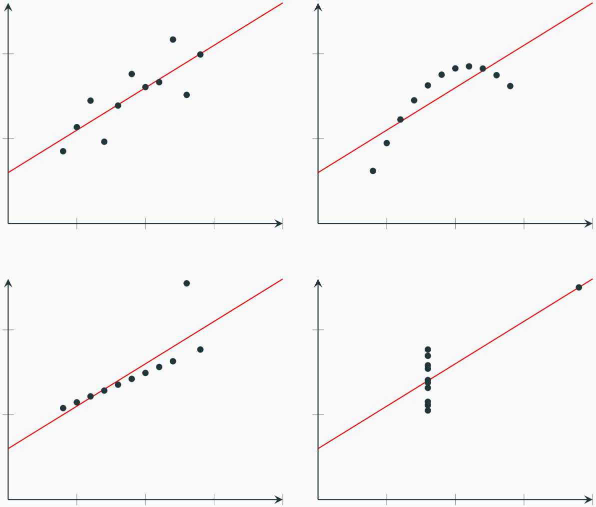


$$ScrapeInterval > 2f$$

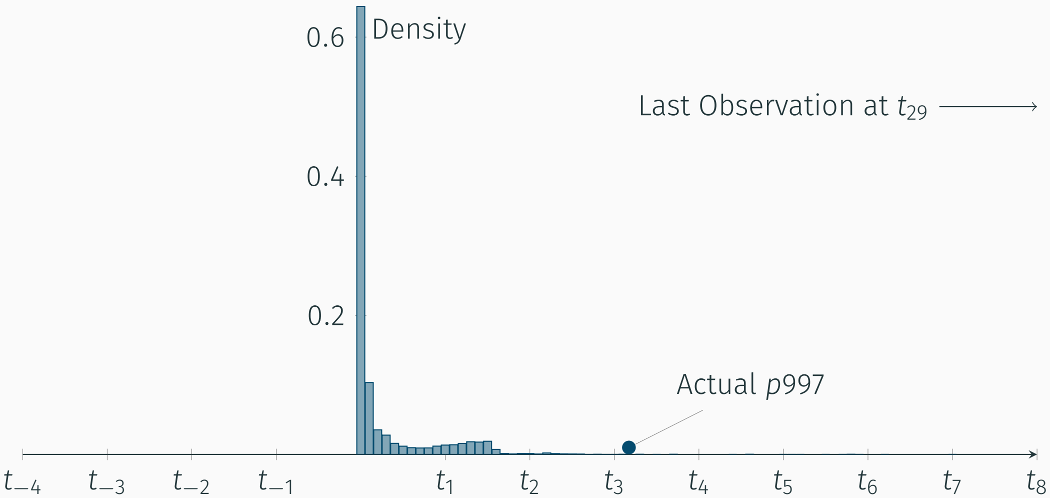
Latency

Anscomb's Quartet

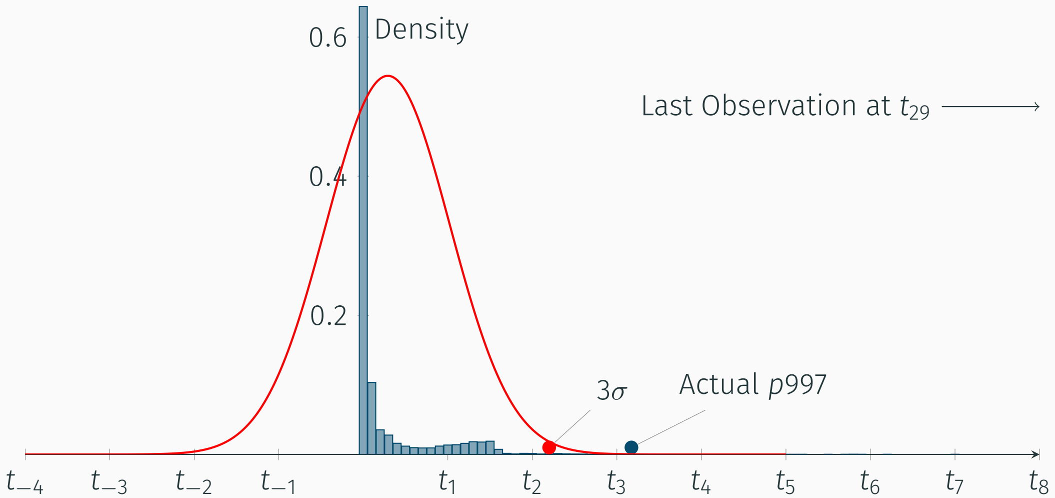
Summary Statistics	
N	11
$\mu\{x_1..x_n\}$	9.0
$\mu\{y_1..y_n\}$	7.5
$\sigma\{x_1..x_n\}$	3.16
$\sigma\{y_1..y_n\}$	1.94
r^2	0.67



Nonstandard Distributions



Nonstandard Distributions



Standard Distribution Curve Formula

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

σ Standard Deviation

μ Mean

e The base of Natural Logarithm and is about 2.71828

π Pi! About 3.14159

Latency Key Takeaways

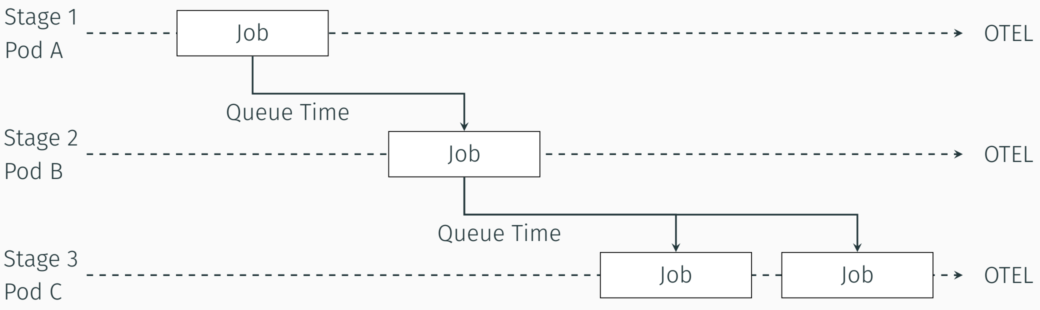
Question Averages

Use Quantiles to Represent Latency Spread

- Median or $q(0.50)$
- $q(0.90)$
- $q(0.95)$
- $q(0.99)$
- 3σ or $q(0.997)$
- Max or $q(1)$

Saturation

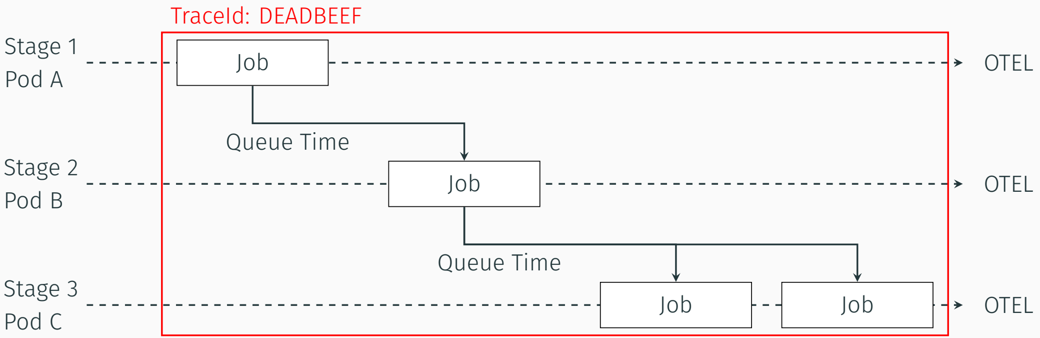
Tracing Pipelines



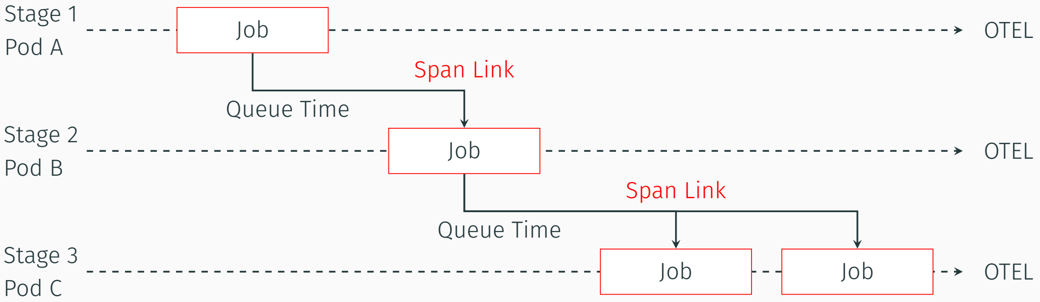
Freshness SLO X% of results are processed in Y time or less over the last Z days.

Saturation SLO X% of results have Y queue time or less over the last Z days.

Tracing Pipelines: How to FAIL



Tracing Pipelines: Using Span Links



Create a TraceId per job and pass context across the bus. Child jobs create a Span Link to reference the TraceId of the parent pipeline job.

Tracing Pipelines: KISS Method

Build a schema and pass meta information along the bus.

```
{
    foo=bar,
    baz=sue
}
```

Health

Of Your Customers

Mission Impossible

Goal: Per Customer Median and Percentiles

Problem: High Volume Log/Event Data

Goal: Summarize Per Customer Data Every 15 Minutes

Problem: Calculating 24 Hour (or longer) Percentiles from Rollups

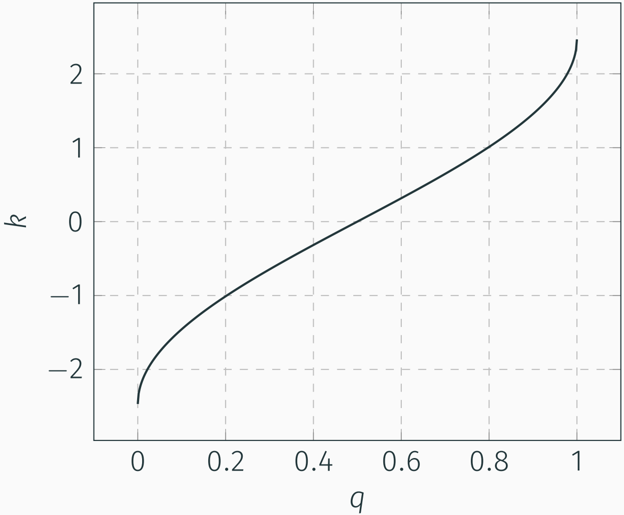
$$k(q) = \frac{\delta}{2\pi} \sin^{-1}(2q - 1)$$

q Quantile (0 – 1 Inclusive)

k Scale Factor

δ Compression Constant

π Everybody run! It's π again!



Results 24 Hour $q(.99)$ Estimations from 15 Minute Rollups

Overall $q(.99)$ had a 2.32% Error

90% of Per Customer $q(.99)$ had $< 50\%$ Error

Figure 1: Example of High Error Customer Distribution