Prometheus PromQL and promtool

Selector http_requests_total{...} `[5m]` → **Range vector** samples per series `rate()` → **Instant vector** one value per series `sum by` → **Aggregated** fewer series

CONCEPTS

An instant query returns one value per series at a single time; a range query evaluates at each step. Selectors give instant vectors, a [5m] suffix gives a range vector, and rate() turns a range vector back into an instant vector.

Counters only go up: always wrap them in rate() or increase() before graphing or summing. Use the plain value only for gauges.

Matchers are fully anchored regexes, so =~"foo" matches only foo. Use =~"foo.*" for prefixes.

SELECTORS

`<metric>`
Instant vector of all series

`<metric>{<label>="<v>"}`
Exact label match

`<metric>{<label>≠"<v>"}`
Label not equal

`<metric>{<label>=~"<re>"}`
Regex match

SELECTORS (cont.)

`<metric>{<label>!~"<re>"}`
Regex non-match

`<metric>[5m]`
Range vector over 5 minutes

`<metric> offset 1h`
Value from one hour ago

COUNTERS AND GAUGES

`rate(<counter>[5m])`
Per-second average rate

`irate(<counter>[5m])`
Rate from the last two samples

`increase(<counter>[1h])`
Total increase over the window

`absent(<metric>{<label>="<v>"})`
1 when no series exist

AGGREGATION

`sum(<expr>)`
Total across all series

`sum by (<label>) (<expr>)`
Sum, keeping only these labels

AGGREGATION (cont.)

`sum without (<label>) (<expr>)`
Sum, dropping these labels

`avg by (<label>) (<expr>)`
Average per group

`max by (<label>) (<expr>)`
Maximum per group

`count by (<label>) (<expr>)`
Number of series per group

`topk(5, <expr>)`
Five largest series

OVER TIME AND HISTOGRAMS

`avg_over_time(<gauge>[1h])`
Average per series over the range

`histogram_quantile(0.95, rate(<m>_bucket[5m]))`
Quantile from buckets

OPERATORS AND LABELS

`<a> / <b>`
Divide series with identical labels

`<a> / on(<label>) <b>`
Match only on these labels

OPERATORS AND LABELS (cont.)

`<a> / ignoring(<label>) <b>`
Match ignoring these labels

`<a> * on(<l>) group_left(<x>) <b>`
Many-to-one join, copy label x

`<expr> > 100`
Keep series above a threshold

Binary operators drop the metric name. Without on() or ignoring(), both sides need identical label sets to pair.

RUNNING THE SERVER

`prometheus --config.file=<file>`
Start with a config file

`prometheus --storage.tsdb.path=<dir>`
Where the TSDB lives

`prometheus --web.enable-lifecycle`
Allow HTTP reload and quit

`curl -X POST <host>:9090/-/reload`
Reload the config

PROMTOOL CHECK

`promtool check config <file>`
Validate config and referenced rule files

`promtool check rules <rules.yml>`
Validate rule files

PROMTOOL QUERY AND TEST

`promtool query instant <url> '<expr>'`
Run an instant query

`promtool query range <url> '<expr>' --start=<t> --end=<t> --step=1m`
Run a range query

`promtool test rules <tests.yml>`
Run rule unit tests

PROMTOOL TSDB AND PUSH

`promtool tsdb analyze <dir>`
Cardinality and churn report