**1. rate()**

Purpose: Calculate the per-second average rate of increase over a time range.

Example: Suppose you have a counter http\_requests\_total that tracks the total number of HTTP requests.

rate(http\_requests\_total[5m])

This query calculates the average rate of incoming HTTP requests per second over the last 5 minutes.

**2. increase()**

Purpose: Calculate the total increase over a time range.

Example: Using the same http\_requests\_total counter.

increase(http\_requests\_total[1h])

This would give the total increase in the number of HTTP requests in the last hour.

**3. irate()**

Purpose: Calculate the instant rate of increase between the last two data points.

Example: For a rapidly changing metric like node\_cpu\_seconds\_total.

irate(node\_cpu\_seconds\_total{mode="system"}[5m])

This query shows the most recent rate of increase in system CPU usage.

**4. delta()**

Purpose: Calculate the difference between the first and last value in a range.

Example: For a gauge metric like node\_memory\_MemFree\_bytes.

delta(node\_memory\_MemFree\_bytes[2h])

This would show the change in free memory over the last 2 hours.

**5. deriv()**

Purpose: Estimate the derivative (rate of change) of a gauge.

Example: For something like node\_temperature\_celsius.

deriv(node\_temperature\_celsius{device="cpu0"}[30m])

This estimates the rate of change of the CPU temperature over the last 30 minutes.

**6. predict\_linear()**

Purpose: Predict the value of a time series in the future.

Example: For predicting disk space usage, say node\_filesystem\_free\_bytes.

predict\_linear(node\_filesystem\_free\_bytes{mountpoint="/"}[1h], 4 \* 3600)

This predicts the amount of free disk space in 4 hours based on the last hour's data.

**7. histogram\_quantile()**

Purpose: Calculate quantiles from histograms.

Example: If you have a histogram http\_request\_duration\_seconds.

histogram\_quantile(0.95, sum(rate(http\_request\_duration\_seconds\_bucket[10m])) by (le))

This calculates the 95th percentile of request durations over the last 10 minutes.

**Basic Queries**

**CPU Usage**

rate(node\_cpu\_seconds\_total{mode!="idle", instance="your-ubuntu-vm:9100"}[5m])

This query calculates the average CPU usage over the last 5 minutes, excluding the idle time.

**Memory Usage**

node\_memory\_MemTotal\_bytes{instance="your-ubuntu-vm:9100"} - node\_memory\_MemFree\_bytes{instance="your-ubuntu-vm:9100"}

This shows the total memory used (total memory - free memory).

**Disk Space Usage**

node\_filesystem\_size\_bytes{instance="your-ubuntu-vm:9100"} - node\_filesystem\_free\_bytes{instance="your-ubuntu-vm:9100"}

This query returns the used disk space.

**Intermediate Queries**

**Average Load Over Time**

avg\_over\_time(node\_load1{instance="your-ubuntu-vm:9100"}[1h])

Calculates the average 1-minute load on the system over the past hour.

**CPU Utilization by Mode**

sum(rate(node\_cpu\_seconds\_total{instance="your-ubuntu-vm:9100"}[5m])) by (mode)

This breaks down the CPU usage by different modes (user, system, iowait, etc.) over the past 5 minutes.

**Memory Utilization Percentage**

(node\_memory\_MemTotal\_bytes{instance="your-ubuntu-vm:9100"} - node\_memory\_MemAvailable\_bytes{instance="your-ubuntu-vm:9100"}) / node\_memory\_MemTotal\_bytes{instance="your-ubuntu-vm:9100"} \* 100

Shows the percentage of memory utilized.

**Advanced Queries**

**CPU Usage Over Time for Each Core**

sum(rate(node\_cpu\_seconds\_total{instance="your-ubuntu-vm:9100", mode!="idle"}[5m])) by (cpu)

This displays the CPU usage for each core separately.

**Disk I/O Utilization**

rate(node\_disk\_io\_time\_seconds\_total{instance="your-ubuntu-vm:9100"}[5m])

Measures the disk I/O utilization over the past 5 minutes.

**Network Bandwidth Usage**

rate(node\_network\_receive\_bytes\_total{instance="your-ubuntu-vm:9100"}[5m]) + rate(node\_network\_transmit\_bytes\_total{instance="your-ubuntu-vm:9100"}[5m])

Calculates the total network bandwidth (receive + transmit) used in the last 5 minutes.

**Advanced Analytical Queries**

**Predict Disk Space Exhaustion**

predict\_linear(node\_filesystem\_free\_bytes{instance="your-ubuntu-vm:9100"}[1h], 24 \* 3600)

Predicts when the disk space will be exhausted in the next 24 hours based on the current trend.

**Anomaly Detection in CPU Usage**

changes(node\_cpu\_seconds\_total{instance="your-ubuntu-vm:9100"}[5m]) > 5

Identifies unusual changes in CPU usage that might indicate an anomaly.

**Top 5 Processes by CPU Usage**

topk(5, rate(process\_cpu\_seconds\_total{instance="your-ubuntu-vm:9100"}[5m]))

Lists the top 5 processes consuming the most CPU.