z/VM 7.2 1Q21 Performance Highlights

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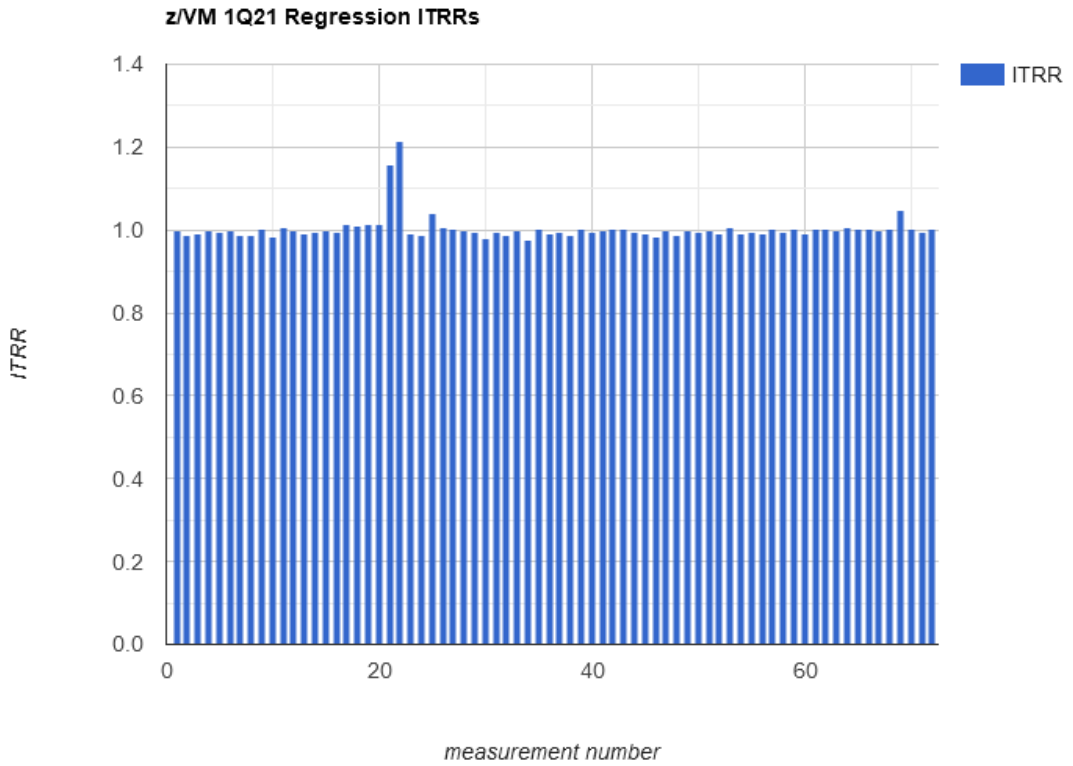
Agenda and Your Takeaways

Agenda item	APAR number	Your takeaway
1Q21 regression results		all good
4 TB exploitation	VM66173	it scales
z/HPF I/O for dumps	VM66431	dump elapsed time -45%
Guest instruction simulation improvements	VM66467	transaction response time -25% steal percent -24%
TCP/IP exploitation of OCSP	z/VM 7.2 base	CPU time per connection -20%
Coping with run variation		We're coping!

Regression Report Card

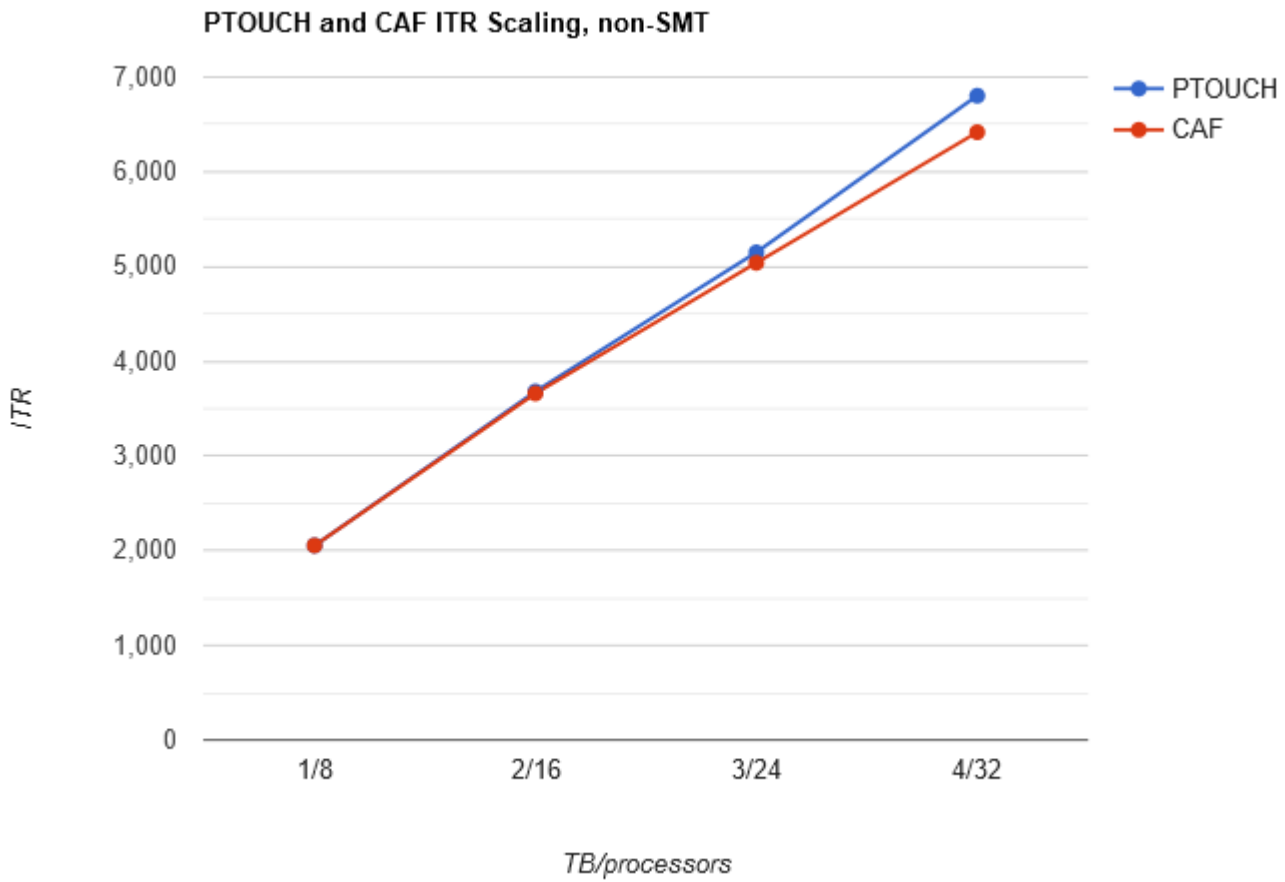
- We run about 70 regression experiments for every z/VM release or bundle of NF APARs
  - These are workloads that do not intentionally exploit new function
  - They are meant to find performance problems a client might find in simply going from z/VM *x* to z/VM *x+1*
- For each workload we collect:
  - "External" transaction rate (ETR): application work accomplished per elapsed second
  - "Internal" transaction rate (ITR): (ETR / (system busy)) = a measure of CPU efficiency
- For each workload we compute regression ratios: ETR(new)/ETR(old) and ITR(new)/ITR(old)
- For z/VM 1Q21 compared back to z/VM 4Q20:
  - ETRR (μ,σ) = (1.004, 0.029) smallest ratio was 0.969
  - ITRR (μ,σ) = (1.004, 0.033) smallest ratio was 0.978
- Analysts: Bill Guzior, Dave Spencer, Xenia Tkatschow, Brian Wade, Dave Wierbowski



The two outliers are workloads that very heavily stress guest page instantiation and release. The 4 TB line item improved that code path. The ITR difference was caused by reduced path length.

4 TB Exploitation: NF APAR VM66173

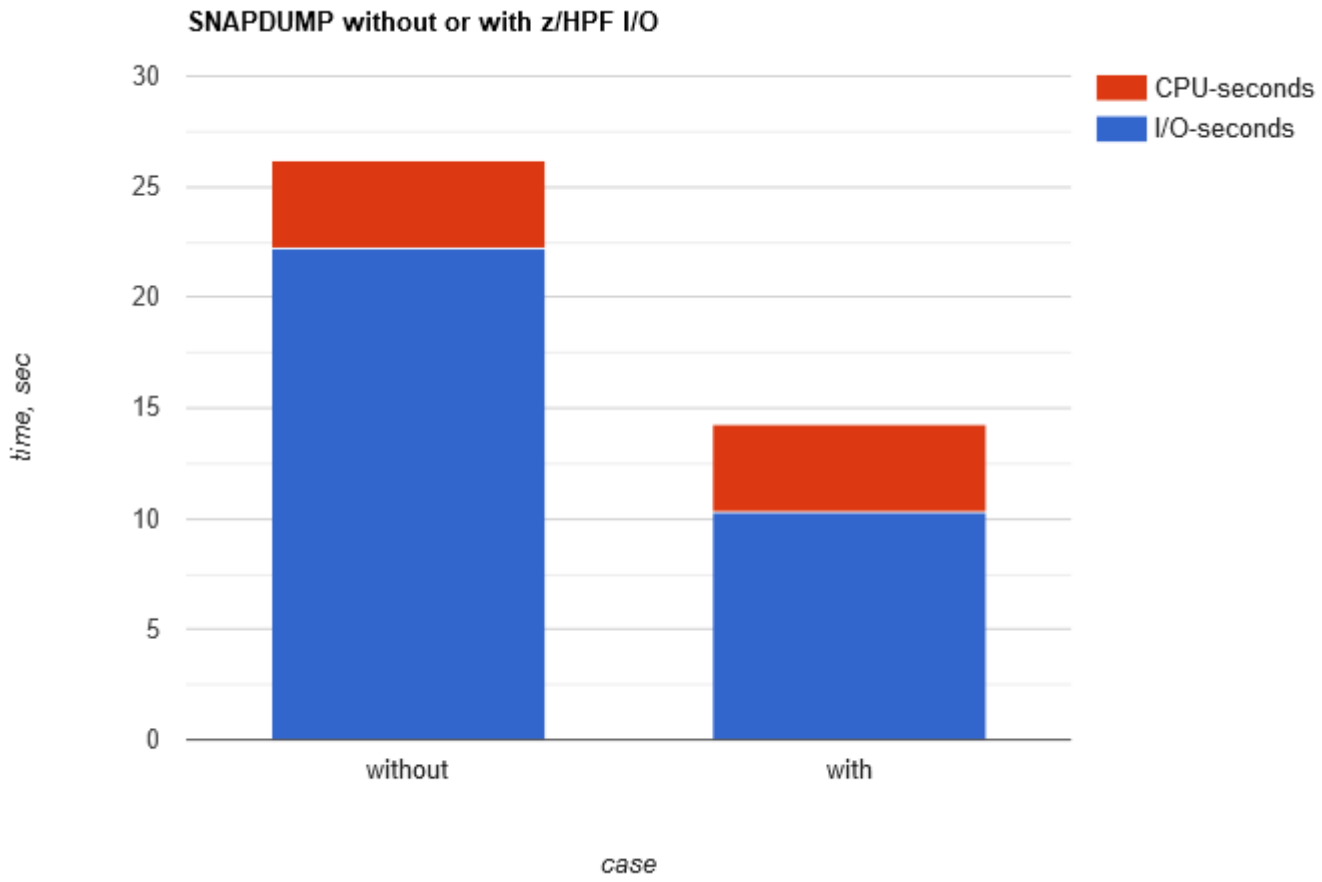
- Exploiting larger hardware is far more than just not abending
- We ran a variety of workloads:
  - Low, medium, high nest pressure
  - Some Linux, some CMS
  - Some memory-rich, some memory-constrained
- What we typically do is run an *arc* of scaling measurements
  - Stepwise ramp-up of workload, processors, and memory
- Net: if the IBM Z hardware can be expected to scale the client's workload, z/VM also can be expected to scale it
- http://www.vm.ibm.com/perf/reports/zvm/html/1q14tb.html
- Analysts: Dave Spencer, Xenia Tkatschow, Brian Wade



NB: **CAF** is the scaling curve predicted by the SYSIB 1.2.2 Capability Adjustment Factor coefficients

z/HPF for Dumps: NF APAR VM66431

- Changed SNAPDUMP, etc. to use z/HPF (transport-mode) I/O instead of ordinary command-mode I/O
- Result:
  - I/O time in the dump was cut by about half (I/O is twice as good)
  - In our measurement, dump elapsed time was cut by 45%
- http://www.vm.ibm.com/perf/reports/zvm/html/1q1dmp.html
- Analysts: Bill Guzior, Brian Wade

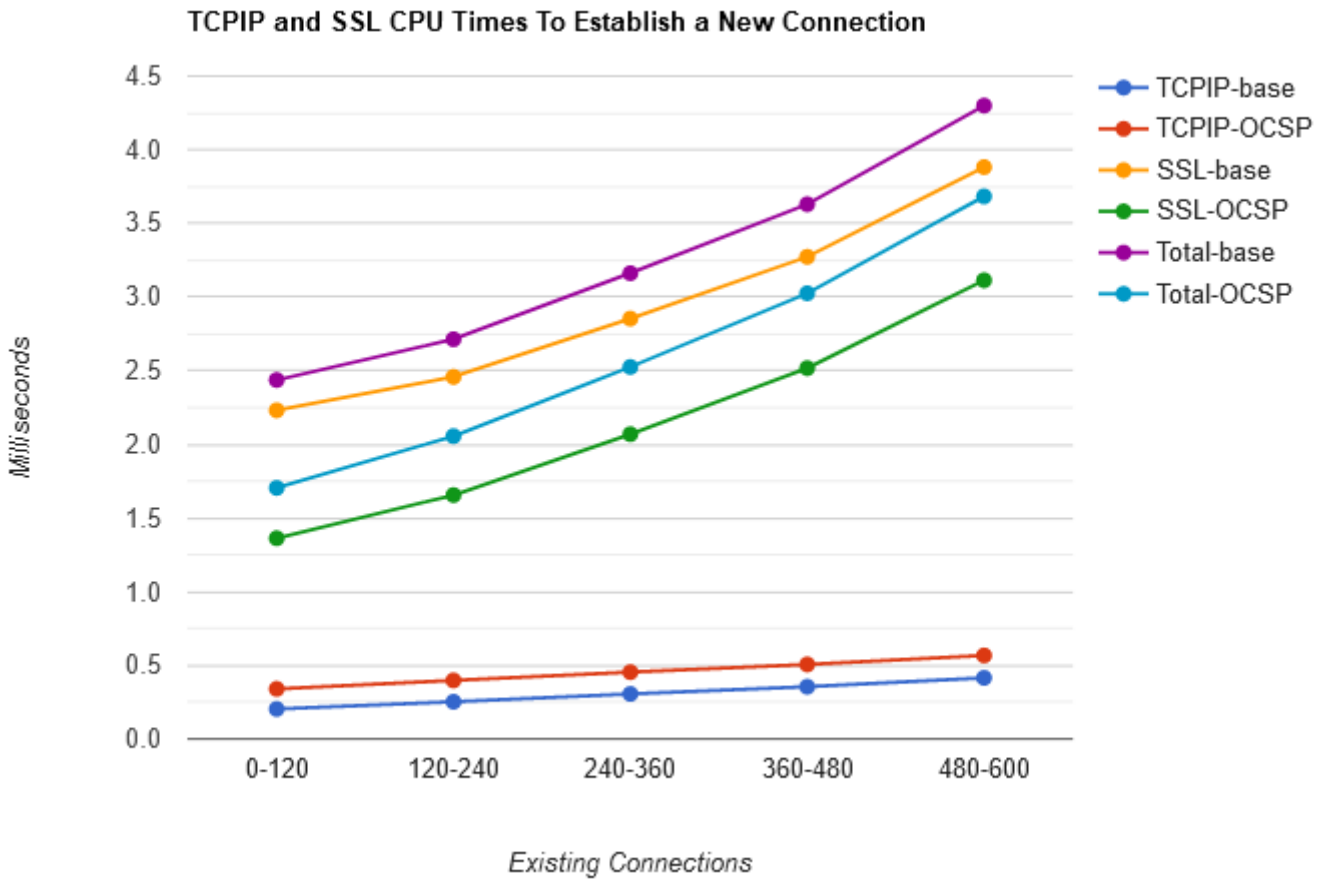


Guest Instruction Simulation Improvements: NF APAR VM66467

- Improved z/VM's simulation of an instruction guests use when interacting with a PCIe adapter
- z/VM CP now talks to the real hardware less often
- Results: in our workload,
  - 25% decrease in transaction response time
  - 24% decrease in guest steal time
- http://www.vm.ibm.com/perf/reports/zvm/html/1q1rpc.html
- Analysts: Marc Beyerle, Thorsten Winkler, Brian Wade

TLS/SSL Server OCSP Exploitation, z/VM 7.2 Base

- Supports Online Certificate Status Protocol (OCSP) and exploits Certificate Distribution Points (CDPs)
- Offloads the validation of client certificates from the z/VM SSL server to an external validation server
- Reduces CPU time needed to establish a new connection with a client
- Overall a 20% decrease in the CPU time needed to establish a new connection
- https://www.vm.ibm.com/perf/reports/zvm/html/1q1ssl.html
- Analyst: Xenia Tkatschow



1Q21 Honorable Mentions

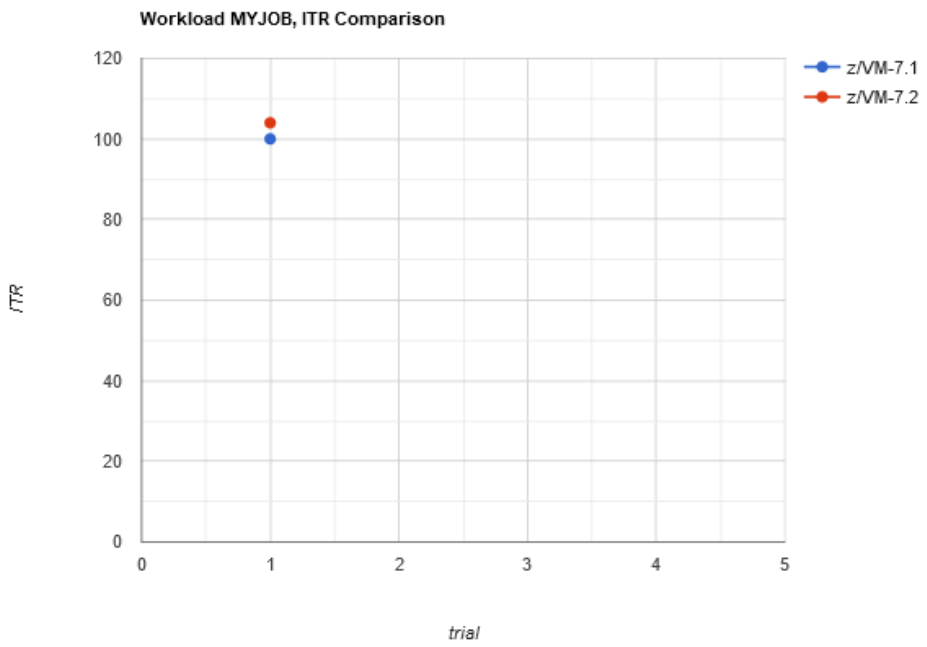
- Fast z/VM Dump Distiller
  - VM66430
  - Decreases time needed to run DUMPLOAD
  - The improvement will vary according to the character of the dump
- z/XC Architecture Support
  - VM66201 (CP), plus VM66425 (CMS), plus VM66489 (Perfkit)
  - After a drought of a few years, we can once again run Perfkit in an XC-mode virtual machine
  - This means we can once again run Perfkit in a guest that is also using SFS Dircontrol in Data Space
  - This made my day!

Coping with Run Variation

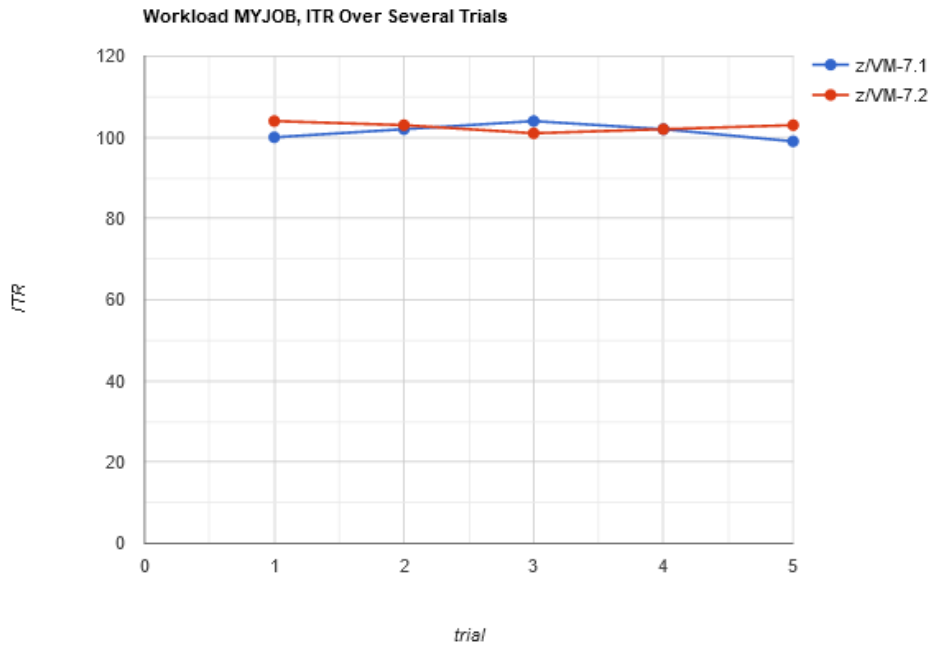
- We want everything to repeat precisely, but it doesn't
  - This is the natural way of the world
  - Especially hits us in measurements using networking or I/O
- To be successful as analysts we need to be on the lookout for variation and cope with it when it happens
- There are mathematical techniques we can use to discern between run variation and true change

We Can Be Misled

- One trial of each experiment showed us a 4% increase
- More trials showed us this is an experiment that naturally varies
- Student's t showed us the difference in the means is not significant
- We can conclude nothing



z/VM 7.1 100
z/VM 7.2 104
change +4%

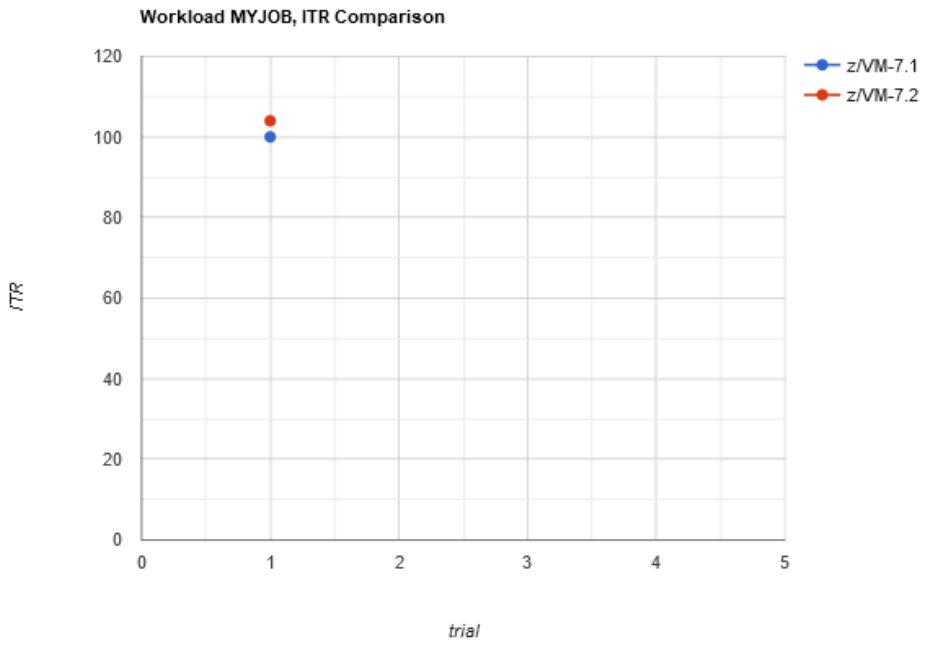


z/VM 7.1 mean 101.4
z/VM 7.2 mean 102.6
change +1.2%

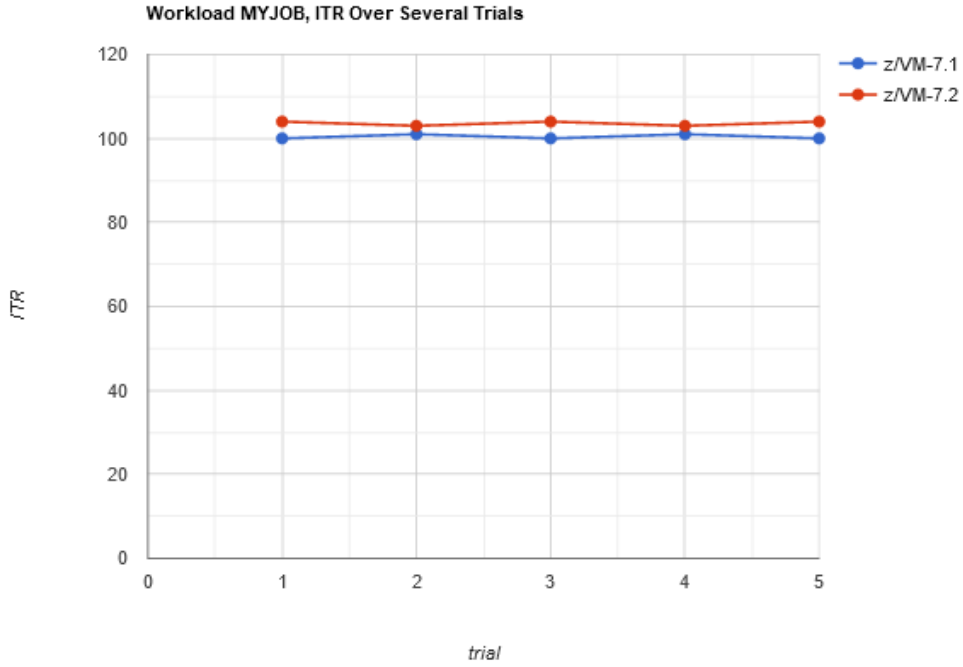
but cl=0
the difference is not meaningful

Detecting Meaningful Change

- One trial of each experiment showed us a 4% increase
- More trials showed us this is an experiment that naturally varies
- Student's t showed us the difference in the means is significant
- We can conclude there was a change



z/VM 7.1 100
z/VM 7.2 104
change +4%



z/VM 7.1 mean 100.4
z/VM 7.2 mean 103.6
change +3.2%

and cl=99%
the difference is meaningful

Repeating Is Not Necessarily Painful

- Maybe your run takes only ten minutes and it's automated
  - So you just repeat it a few times
- Maybe your run is like this:
  - It runs for ten minutes, and
  - It emits measurement data at 1-minute intervals, and
  - It also collects a sample of ETR at 1-minute intervals
  - In this case your run is really ten 1-minute experiments
- If your ETR is something tracked in monitor sample records, you're golden
  - For example, throughput of a vswitch uplink port

Our Networking and I/O Analyst: Dave W

- His runs are very heavily automated
- Each run takes about five minutes
- So, for each workload, he
  - Collects N trials of, say, 4Q20
  - Collects N trials of, say, 1Q21
  - Uses student's t to check whether the difference of the means is statistically significant
- Is the difference of the means statistically significant at cl>=95?
  - Yes: investigate
  - No: move on
- This helps him not to be misled by natural run variation

Summary

Regression performance our clients expect

Clients should be able to run a 4 TB partition just fine

Nice improvement for dumps

More and more relevant as clients' systems become larger

Nice improvement for guest PCIe workloads

Nice improvement from OCSP

We are coping with run variation