Repeatability Test

Young-Kyoon Suh

April 20, 2017

1 Description

This document presents two sets of histograms based on the two runs of a program under test, called *INC*, with a set of increasing task lengths from 1 second to 4096 seconds. We would like to see if both of the sets have the same shape for the same task length. If so then, we can say that run repeatability is satisfied in our experiment setting. In this study the used protocol is equivalent to SEDONA, eliminating samples involving infrequent, long-running daemons, which is the first step of EMPv5. In other words, the protocol skips the second step of EMPv5 that removes samples with process times over/below two standard deviations from the average after performing the first step.

Now we show histograms of elapsed time (ET) and process time (PT) of INC via the SEDONA protocol.

2 Histograms on the First Run

This section exhibits histograms on the first run of INC with its task length increasing from 1 second to 4096 seconds, via SEDONA. The detailed description of the base data is from Table 1.

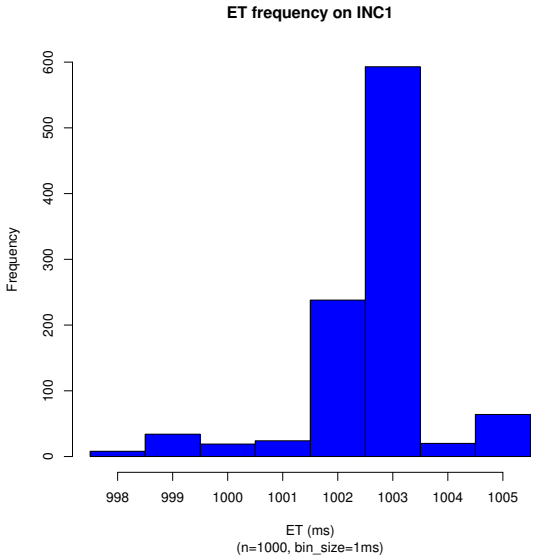
3 Experiment Notes

Table 1 provides a short description of our experimental runs, on which the following histograms are based.

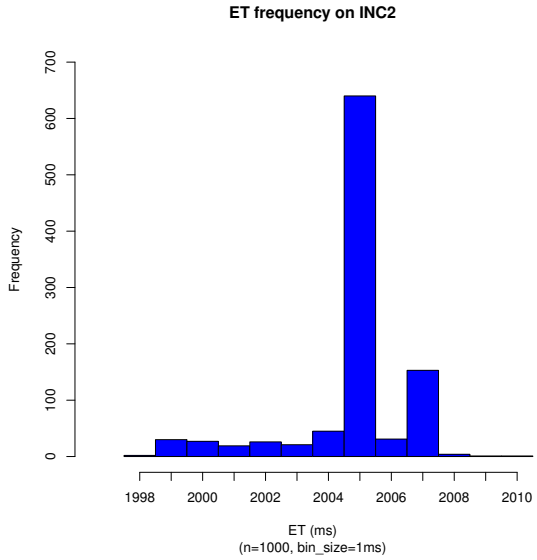
Machine	Task Length (sec)	Description	Experiment Period	Relevant Histograms
`sodb9`	INC1∼INC64	1000 samples, each	2017-03-02 ∼ 2017-03-04	Figs. 1, 2, 5, and 6
`sodb9`	INC128∼INC1024	300 samples, each	2017-03-04 ∼ 2017-03-11	Figs. 3 and 7
`sodb10`	INC2048	300 samples	2017-03-02 ∼ 2017-03-09	Figs. 4(a) and 8(a)
`sodb12`	INC4096	300 samples	2017-02-13 ∼ 2017-02-27	Figs. 4(b) and 8(b)

Table 1: Notes on experiment runs used for histograms

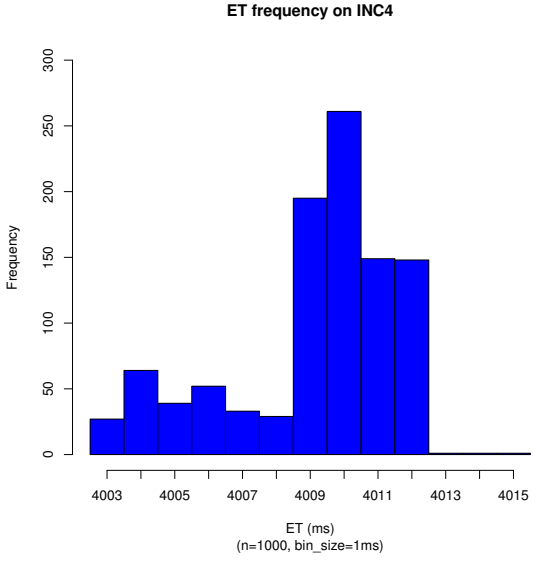
3.1 ET



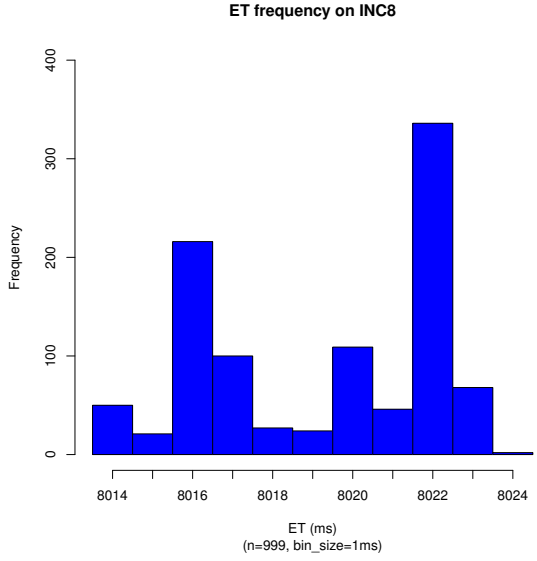
(a) ET frequency on INC1



(b) ET frequency on INC2

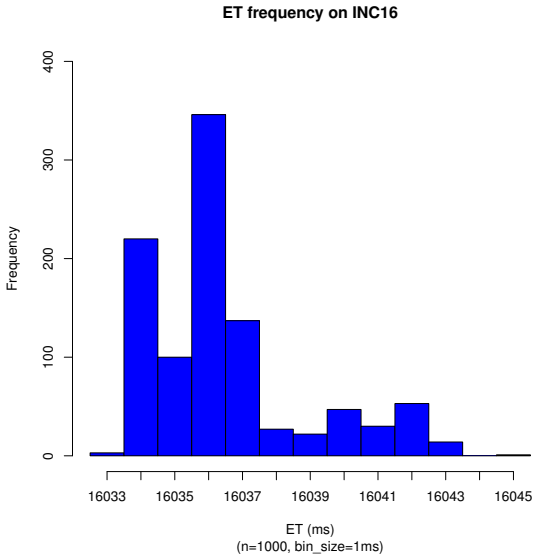


(c) ET frequency on INC4

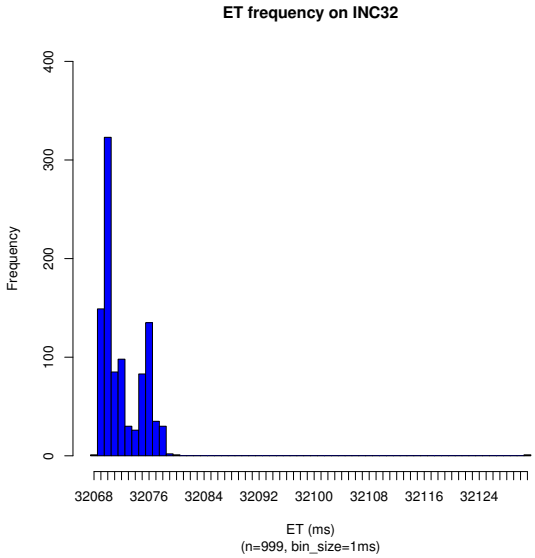


(d) ET frequency on INC8

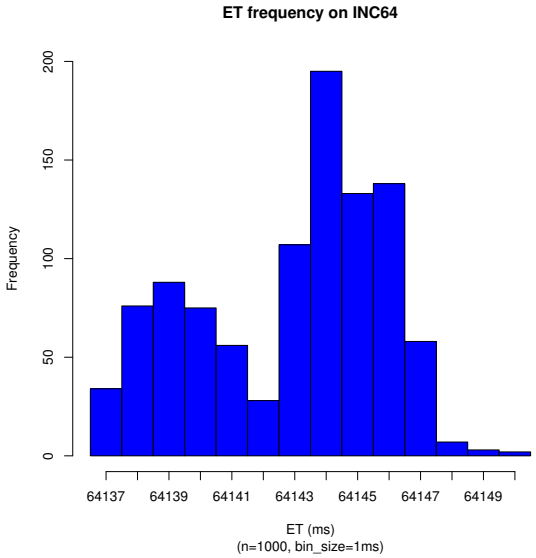
Figure 1: ET Histograms of INC1 ... INC8



(a) ET frequency on INC16

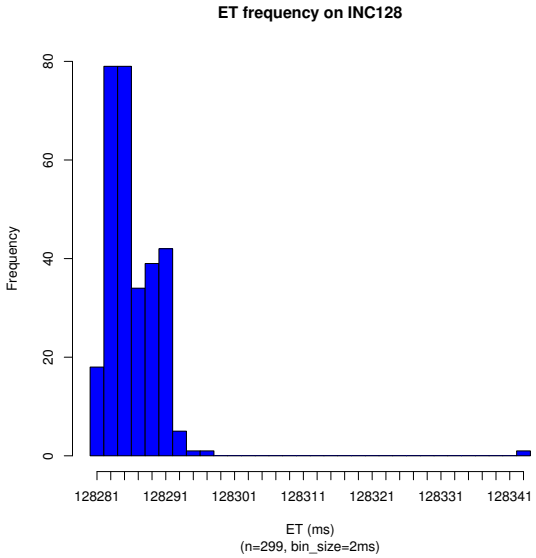


(b) ET frequency on INC32

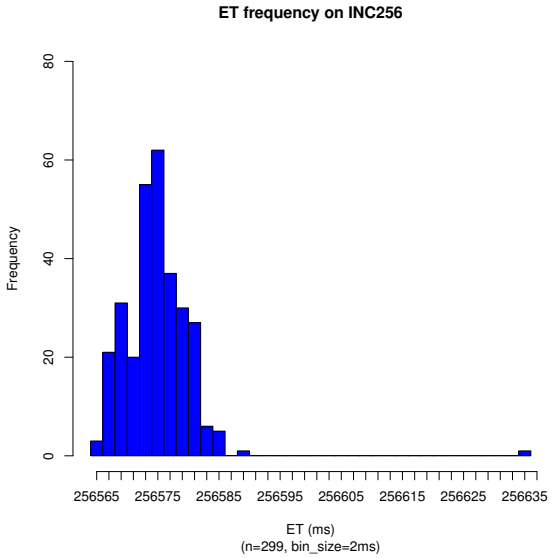


(c) ET frequency on INC64

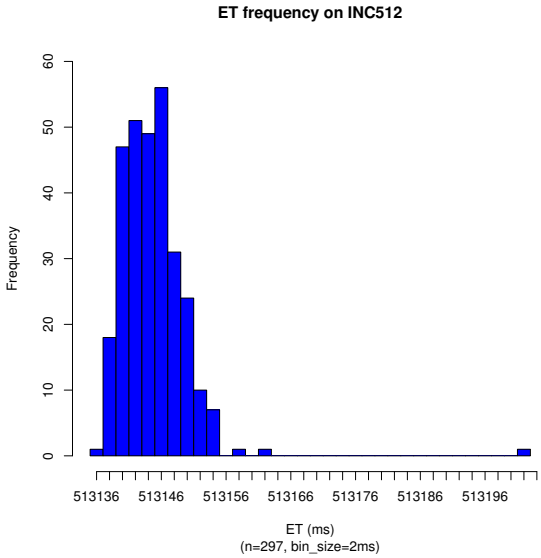
Figure 2: ET Histograms of INC16 ... INC64



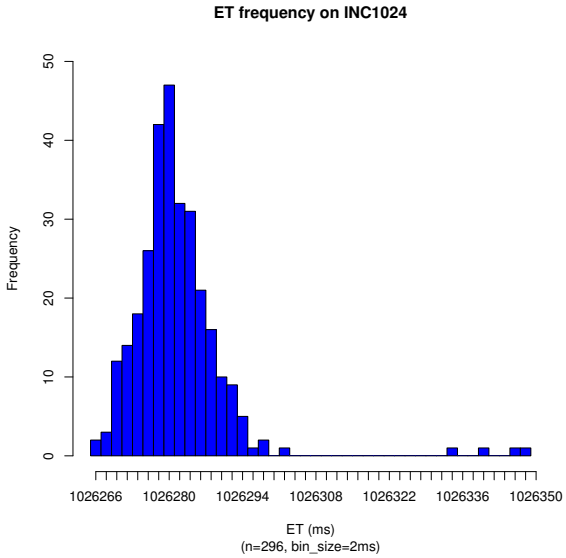
(a) ET frequency on INC128



(b) ET frequency on INC256

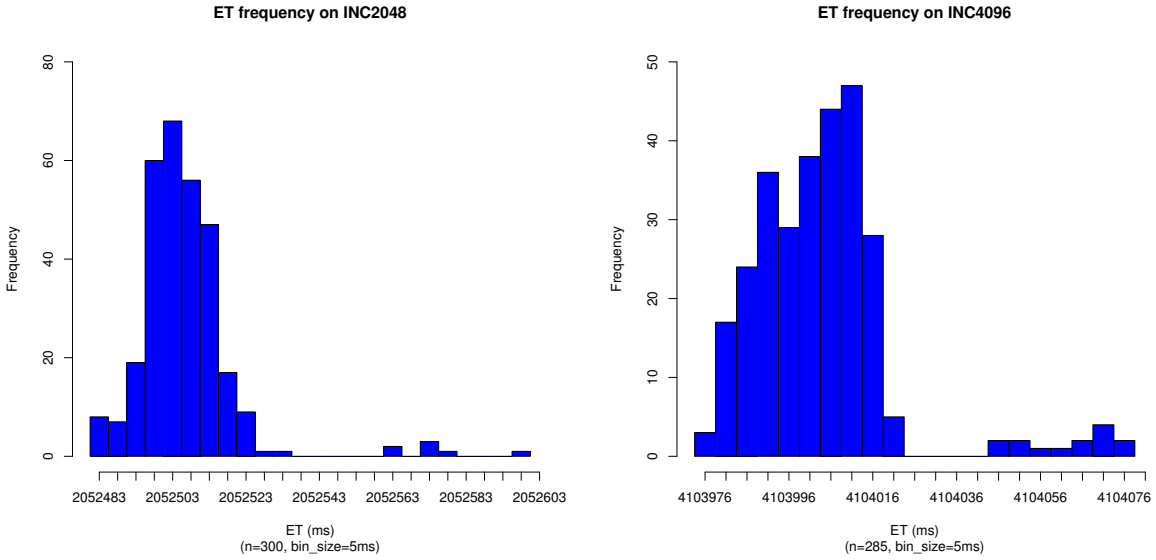


(c) ET frequency on INC512



(d) ET frequency on INC1024

Figure 3: ET Histograms of INC128 ... INC1024

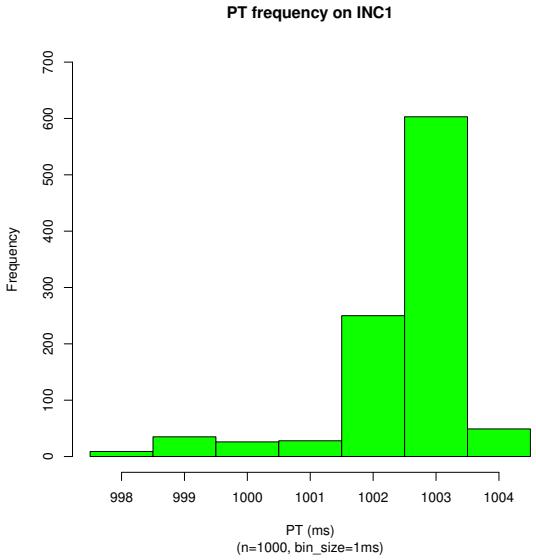


(a) ET frequency on INC2048

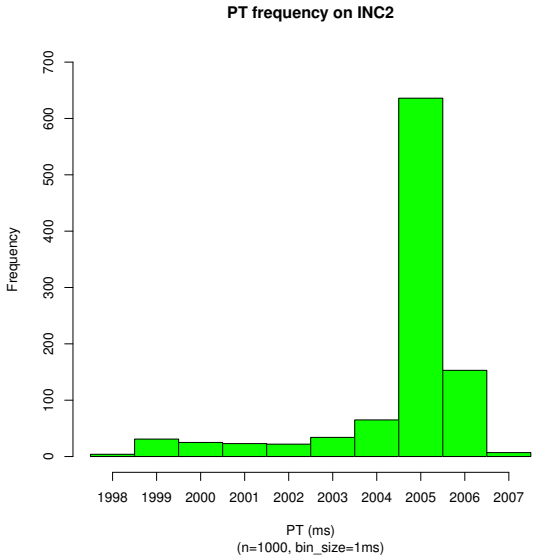
(b) ET frequency on INC4096

Figure 4: ET Histograms of INC2048 and INC4096

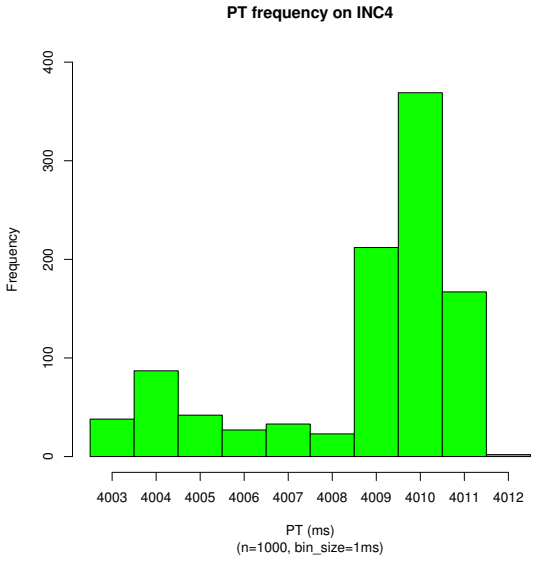
3.2 PT



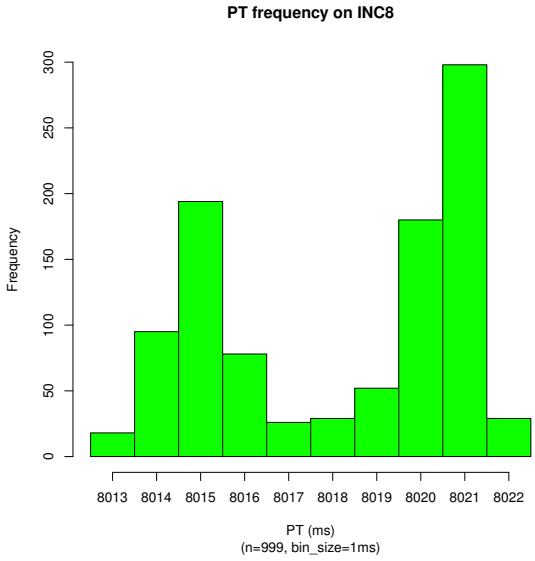
(a) PT frequency on INC1



(b) PT frequency on INC2

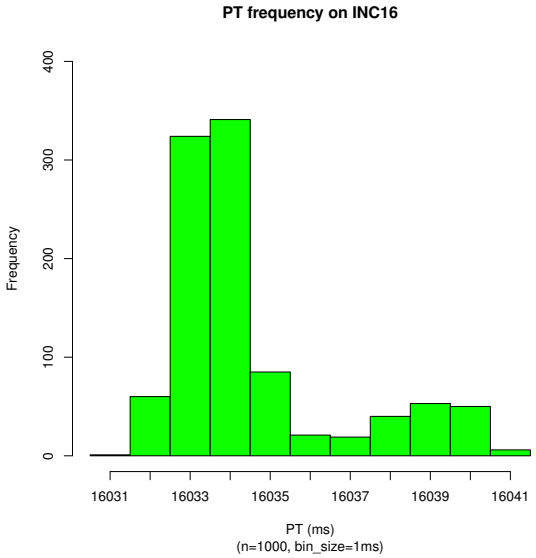


(c) PT frequency on INC4

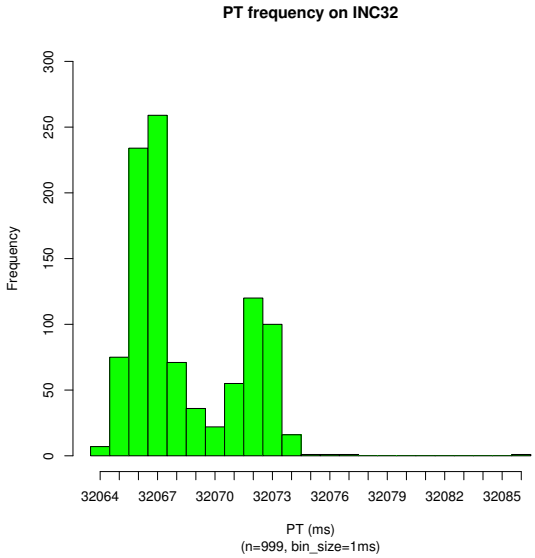


(d) PT frequency on INC8

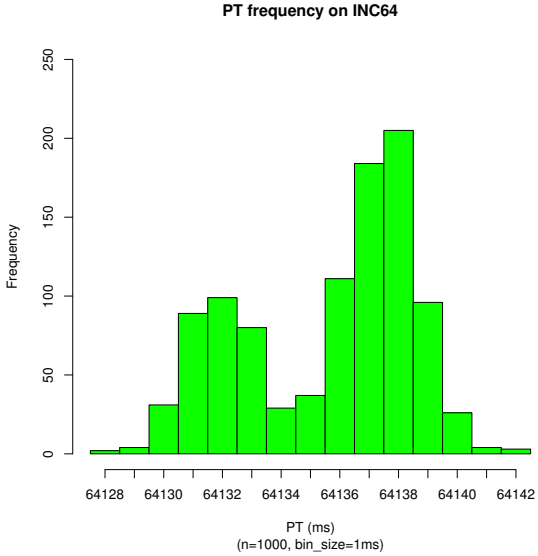
Figure 5: PT Histograms of INC1 ... INC8



(a) PT frequency on INC16

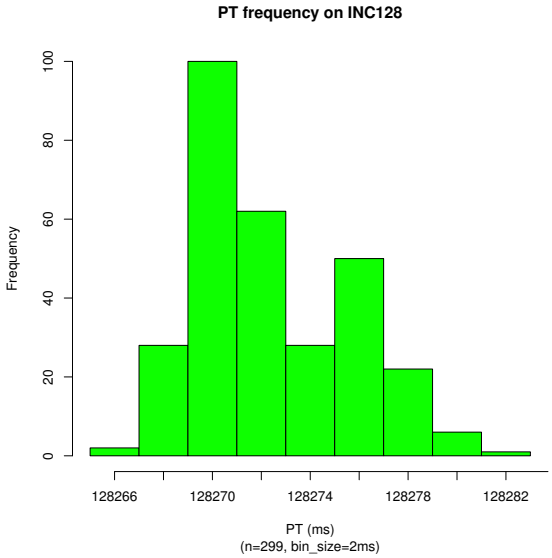


(b) PT frequency on INC32

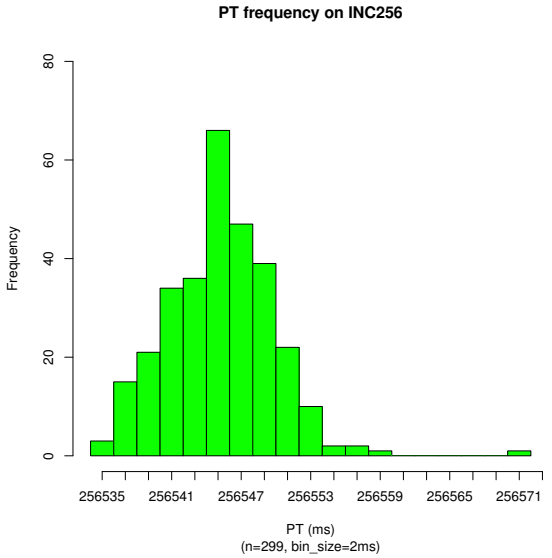


(c) PT frequency on INC64

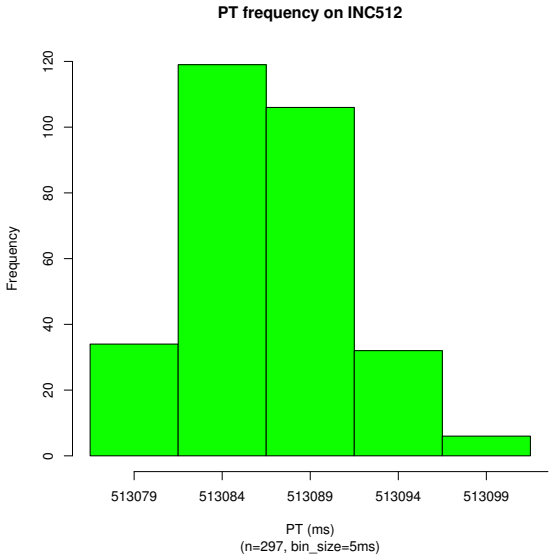
Figure 6: PT Histograms of INC16 ... INC64



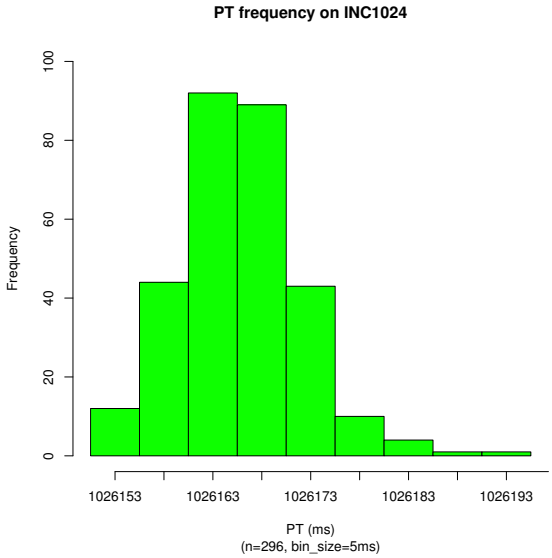
(a) PT frequency on INC128



(b) PT frequency on INC256

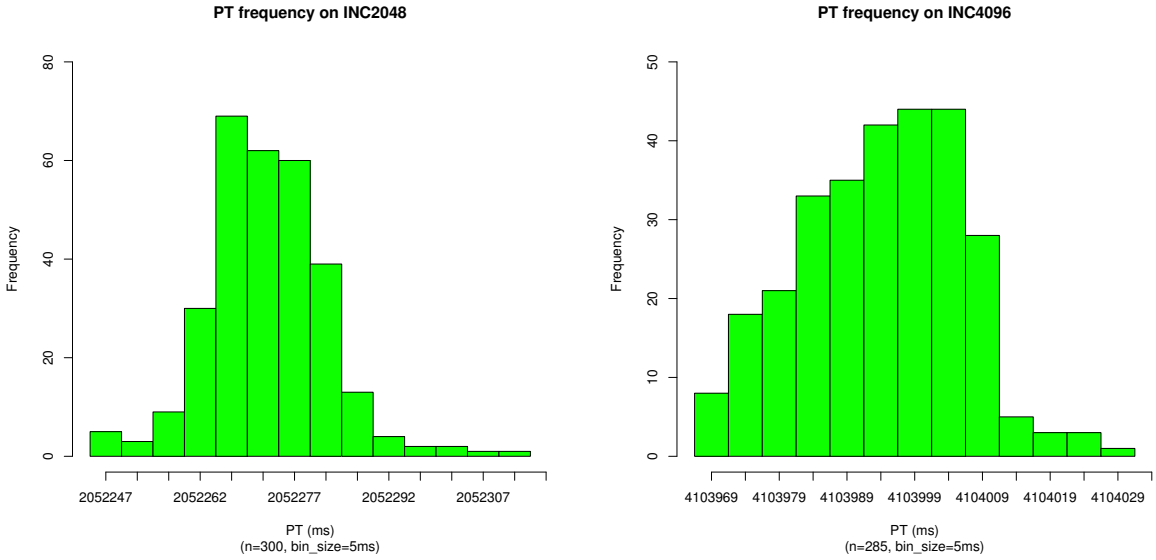


(c) PT frequency on INC512



(d) PT frequency on INC1024

Figure 7: PT Histograms of INC256 ... INC1024



(a) PT frequency on INC2048

(b) PT frequency on INC4096

Figure 8: PT Histograms of INC2048 and INC4096

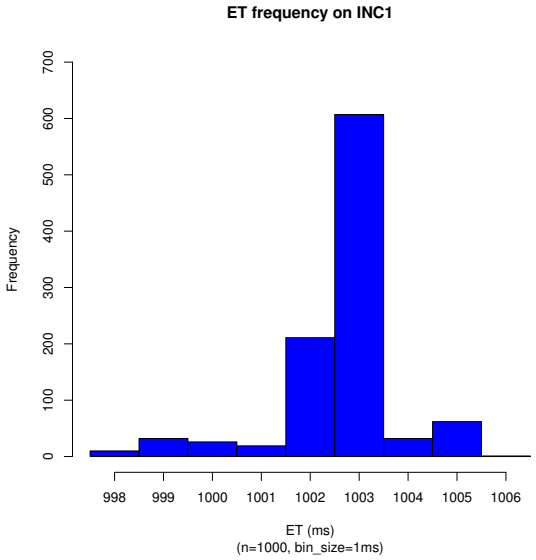
4 Histograms on the Second Run

This section exhibits histograms on the second run of INC with its task length increasing from 1 second to 4096 seconds, via SEDONA. The detailed description of the base data is from Table 2.

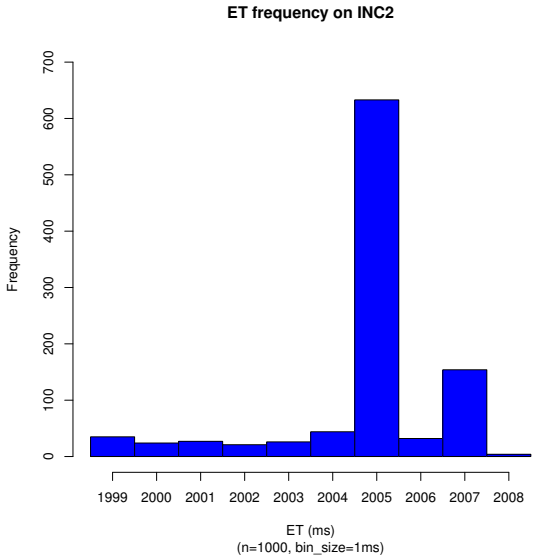
Machine	Task Length (sec)	Description	Experiment Period	Relevant Histograms
`sodb9`	INC1∼INC64	1000 samples, each	2017-03-13 ∼ 2017-03-14	Figs. 9, 10, 13, and 14
`sodb9`	INC128∼INC1024	300 samples, each	2017-03-14 ∼ 2017-03-21	Figs. 11 and 15
`sodb10`	INC2048	300 samples	2017-03-13 ∼ 2017-03-20	Figs. 12(a) and 16(a)
`sodb12`	INC4096	300 samples	2017-03-02 ∼ 2017-03-17	Figs. 12(b) and 16(b)

Table 2: Notes on experiment runs used for histograms

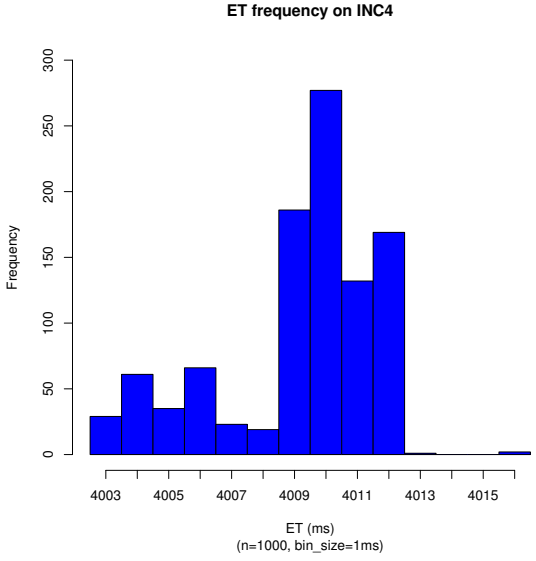
4.1 ET



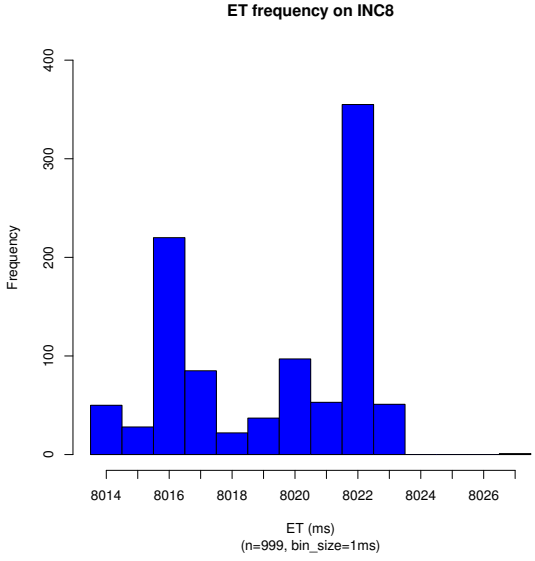
(a) ET frequency on INC1



(b) ET frequency on INC2

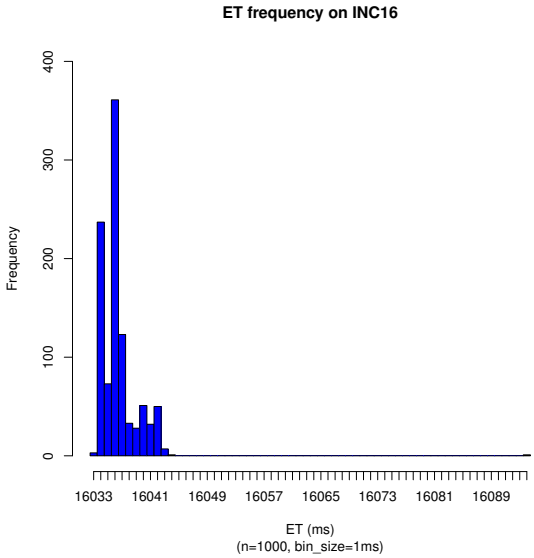


(c) ET frequency on INC4

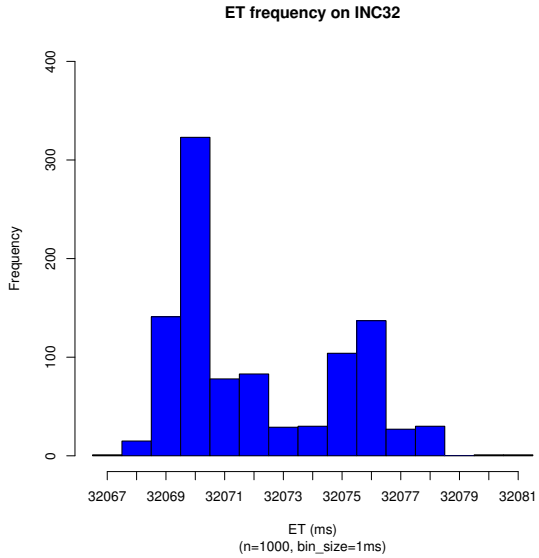


(d) ET frequency on INC8

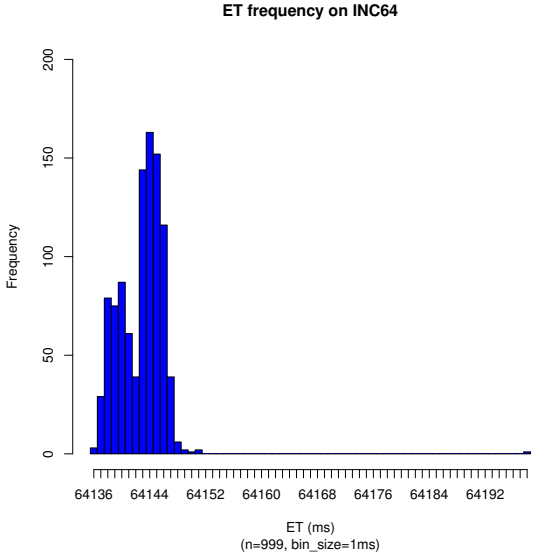
Figure 9: ET Histograms of INC1 ... INC8



(a) ET frequency on INC16

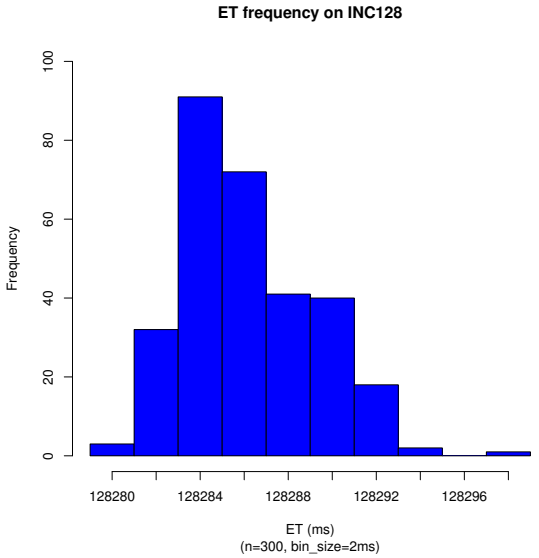


(b) ET frequency on INC32

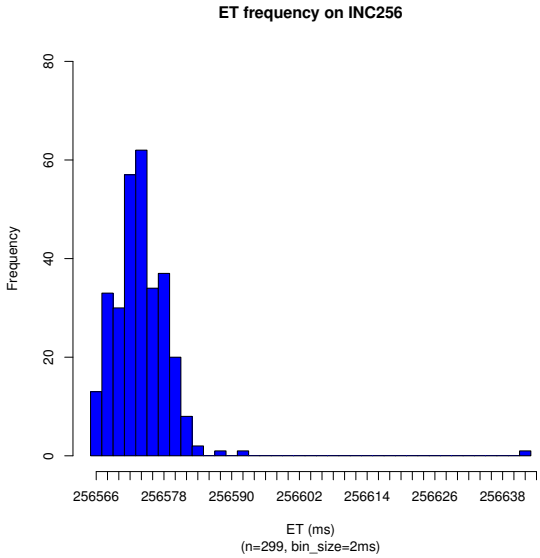


(c) ET frequency on INC64

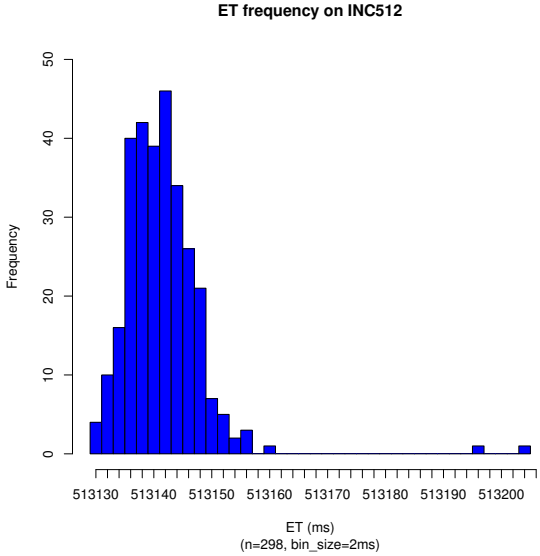
Figure 10: ET Histograms of INC16 ... INC64



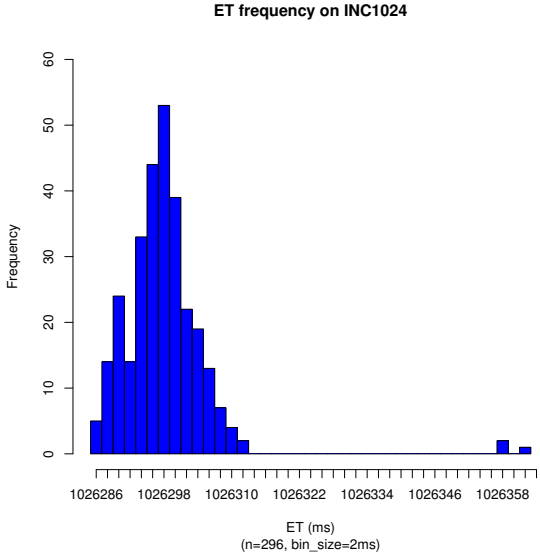
(a) ET frequency on INC128



(b) ET frequency on INC256

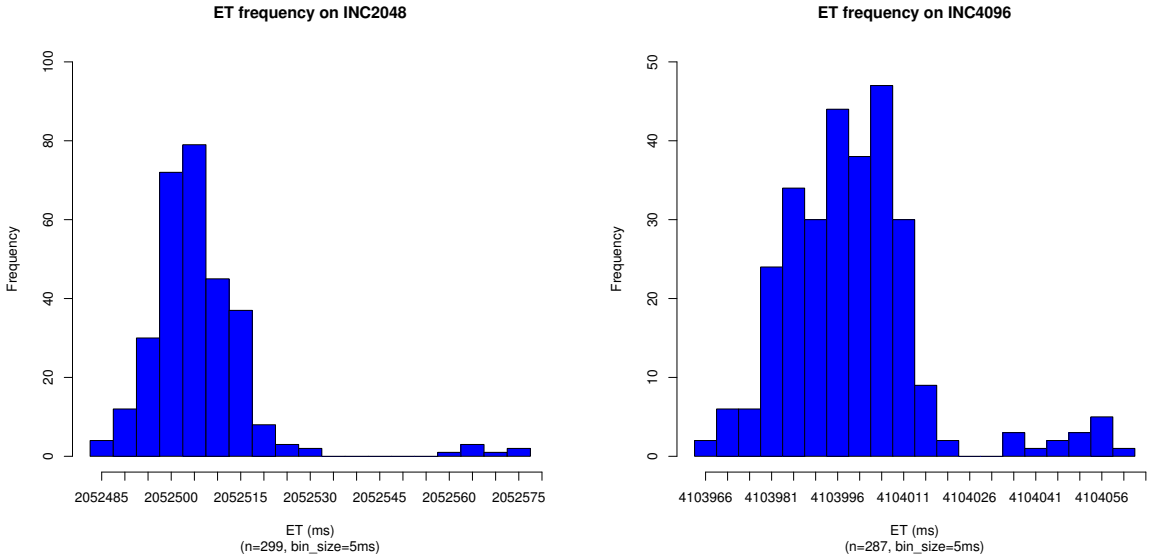


(c) ET frequency on INC512



(d) ET frequency on INC1024

Figure 11: ET Histograms of INC128 ... INC1024

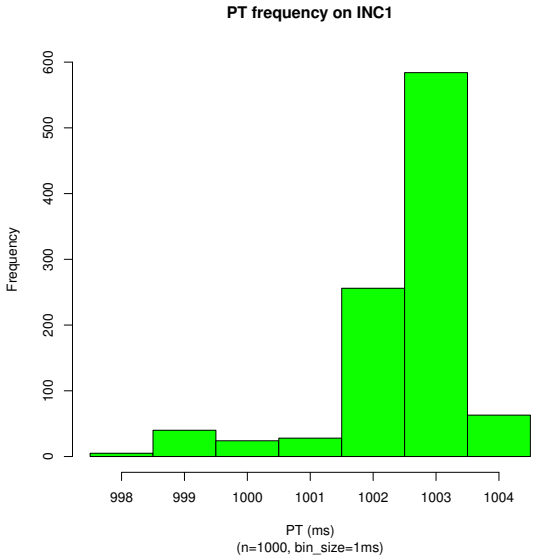


(a) ET frequency on INC2048

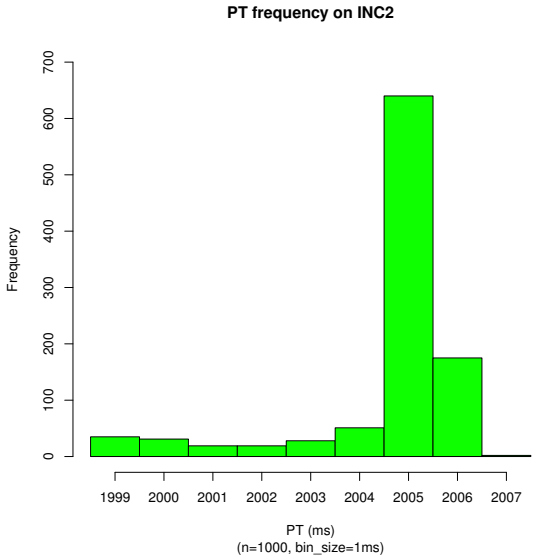
(b) ET frequency on INC4096

Figure 12: ET Histograms of INC2048 and INC4096

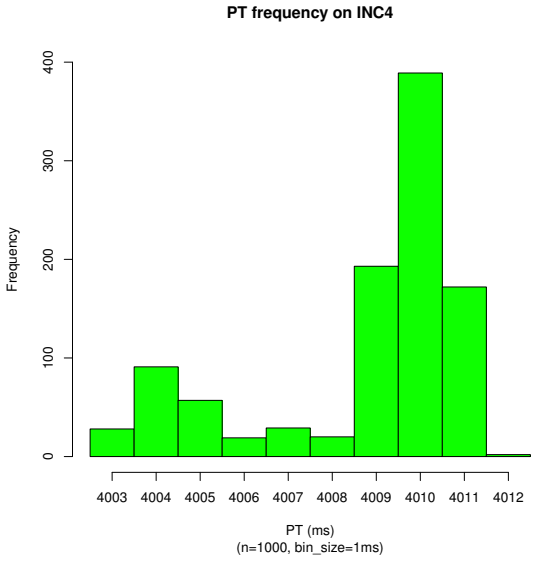
4.2 PT



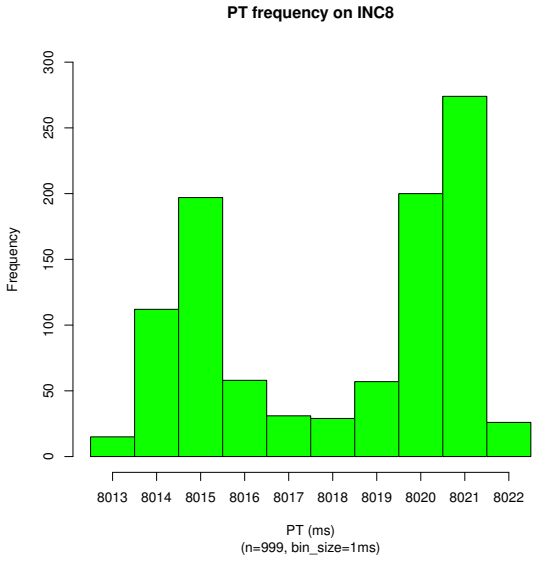
(a) PT frequency on INC1



(b) PT frequency on INC2

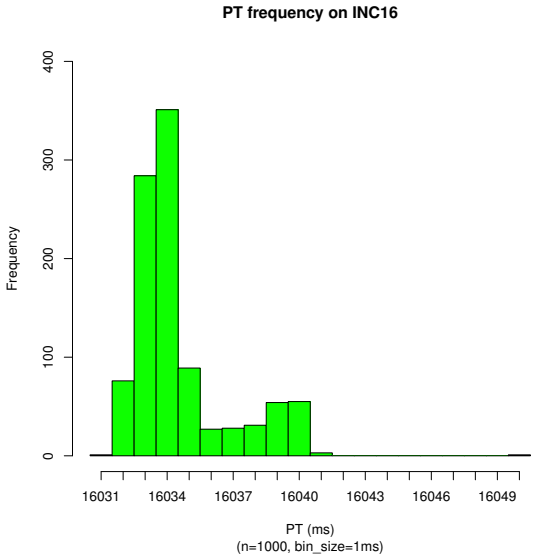


(c) PT frequency on INC4

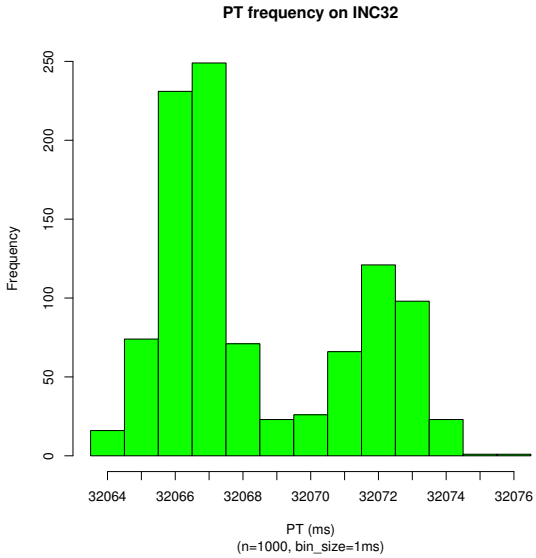


(d) PT frequency on INC8

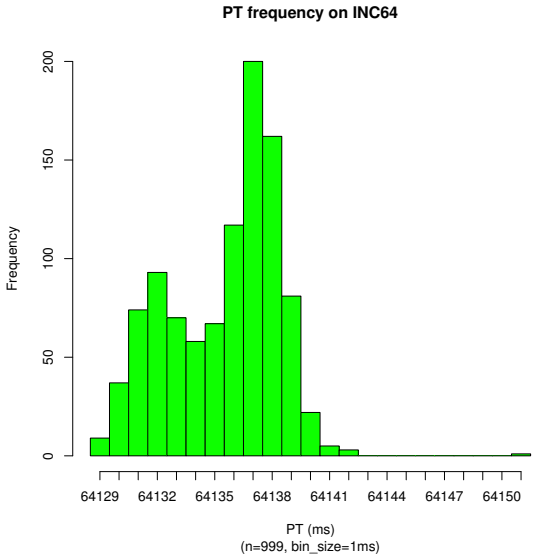
Figure 13: PT Histograms of INC1 ... INC8



(a) PT frequency on INC16

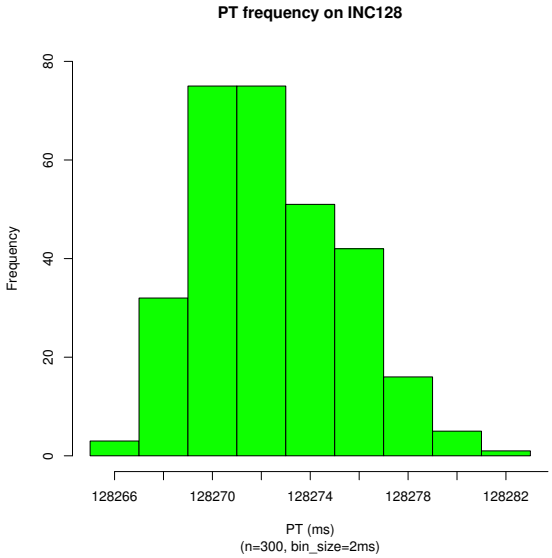


(b) PT frequency on INC32

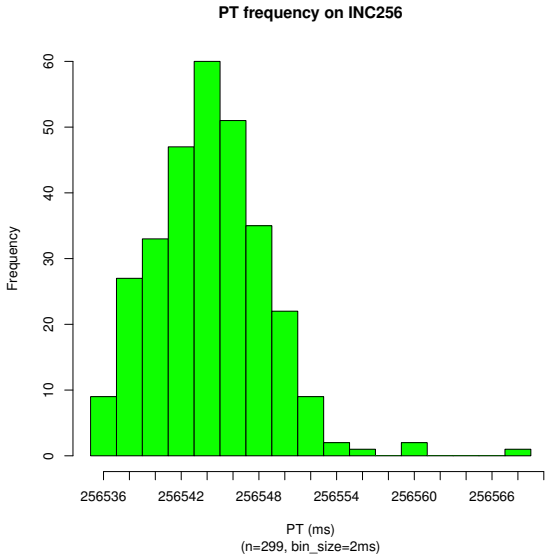


(c) PT frequency on INC64

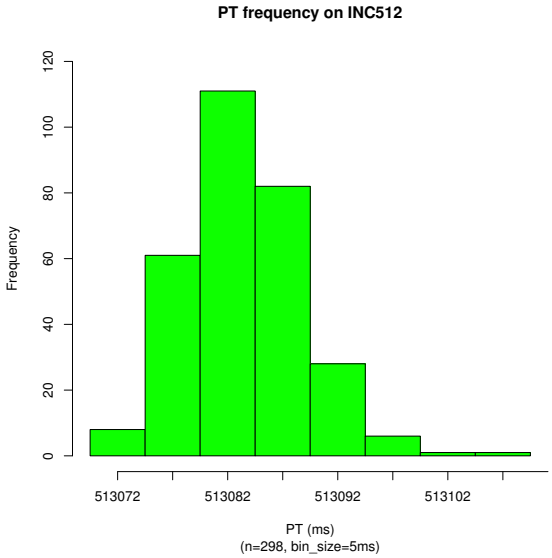
Figure 14: PT Histograms of INC16 ... INC64



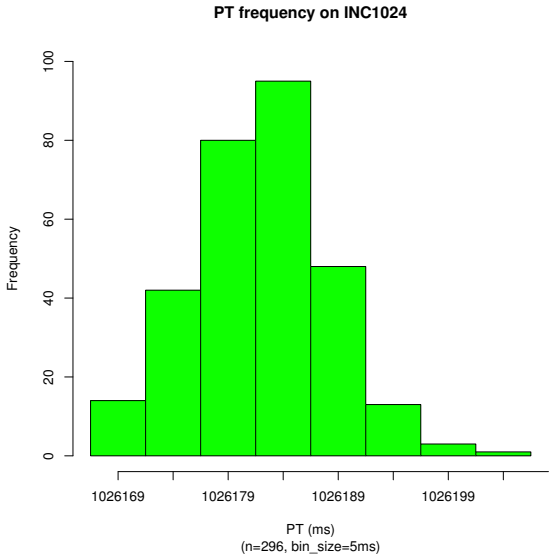
(a) PT frequency on INC128



(b) PT frequency on INC256

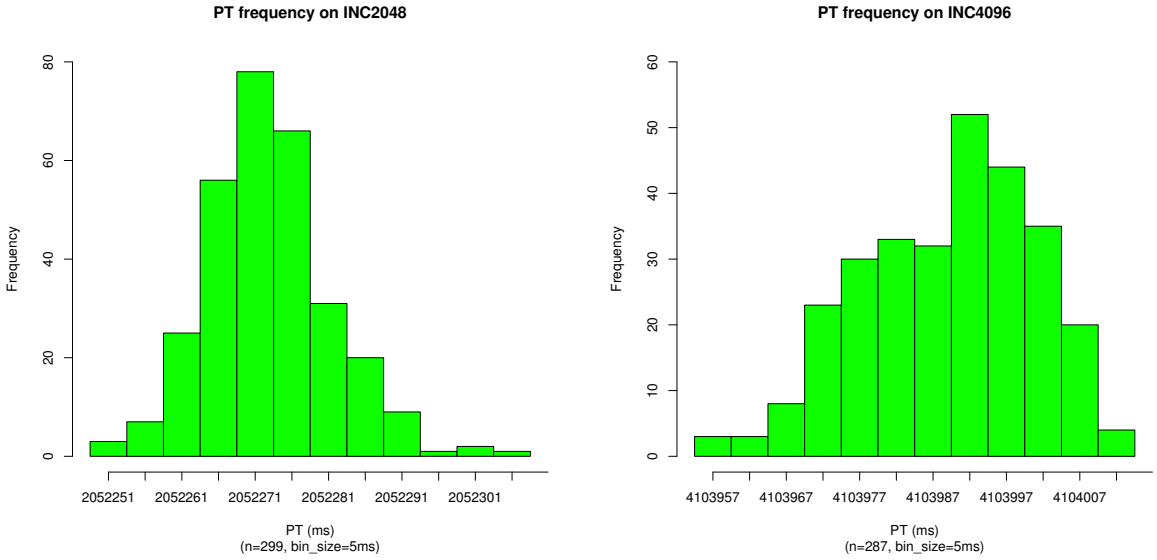


(c) PT frequency on INC512



(d) PT frequency on INC1024

Figure 15: PT Histograms of INC256 ... INC1024



(a) PT frequency on INC2048

(b) PT frequency on INC4096

Figure 16: PT Histograms of INC2048 and INC4096

4.2.1 Analysis

In this section we look into what happened inside the peaks observed in a certain histogram. We consider Figure 13(d) for this study. In the figure, we see the peaks at 8015 msec, 8020 msec, and 8021 msec.

Table 3 shows captured daemons and their runtime statistics per bin of figure. Note that bin is at the unit of PT. It appears that the peaks are definitely correlated with (1) appearances of some daemons and (2) times that those daemons co-ran with INC8.

TASK_LEN	BIN (PT)	DAEMON	MIN_PT	MAX_PT	AVG_PT	STD_PT	Counts
INC8	8013	jbd2/md0-8	1	1	1	0	1
INC8	8013	kslowd000	1	1	1	0	1
INC8	8013	md0_raid1	1	1	1	0	17
INC8	8013	proc_monitor	196	200	197.72	1.07	18
INC8	8014	jbd2/md0-8	1	1	1	0	5
INC8	8014	kslowd000	1	1	1	0	35
INC8	8014	kslowd001	1	1	1	0	26
INC8	8014	md0_raid1	1	1	1	0	58
INC8	8014	proc_monitor	196	200	197.31	1.06	95
INC8	**8015**	java	2	7	4.5	3.54	2
INC8	**8015**	jbd2/md0-8	1	1	1	0	2
INC8	**8015**	kslowd000	1	1	1	0	86
INC8	**8015**	kslowd001	1	1	1	0	89
INC8	**8015**	md0_raid1	1	1	1	0	18
INC8	**8015**	proc_monitor	196	200	197.28	1.01	194
INC8	8016	kslowd000	1	1	1	0	36
INC8	8016	kslowd001	1	1	1	0	40
INC8	8016	md0_raid1	1	1	1	0	8
INC8	8016	proc_monitor	196	200	196.45	.95	78
INC8	8017	kslowd000	1	1	1	0	11
INC8	8017	kslowd001	1	1	1	0	10
INC8	8017	md0_raid1	1	1	1	0	3
INC8	8017	proc_monitor	196	200	197.15	1.16	26
INC8	8018	kslowd000	1	1	1	0	13
INC8	8018	kslowd001	1	1	1	0	9
INC8	8018	md0_raid1	1	1	1	0	6
INC8	8018	proc_monitor	196	200	197.24	1.27	29
INC8	8019	jbd2/md0-8	1	1	1	0	3
INC8	8019	kslowd000	1	1	1	0	9
INC8	8019	kslowd001	1	2	1.06	.24	18
INC8	8019	md0_raid1	1	1	1	0	27
INC8	8019	proc_monitor	196	200	197.1	1.18	52
INC8	**8020**	jbd2/md0-8	1	1	1	0	8
INC8	**8020**	kslowd000	1	1	1	0	52
INC8	**8020**	kslowd001	1	1	1	0	57
INC8	**8020**	md0_raid1	1	1	1	0	91
INC8	**8020**	proc_monitor	196	200	197.03	1.02	180
INC8	**8021**	cifsd	1	1	1	0	1
INC8	**8021**	java	2	37	19.5	24.75	2
INC8	**8021**	kslowd000	1	1	1	0	146
INC8	**8021**	kslowd001	1	1	1	0	143
INC8	**8021**	md0_raid1	1	1	1	0	11
INC8	**8021**	proc_monitor	196	198	197.15	.98	299
INC8	8022	kslowd000	1	1	1	0	20
INC8	8022	kslowd001	1	1	1	0	9
INC8	8022	proc_monitor	196	198	196.07	.37	29

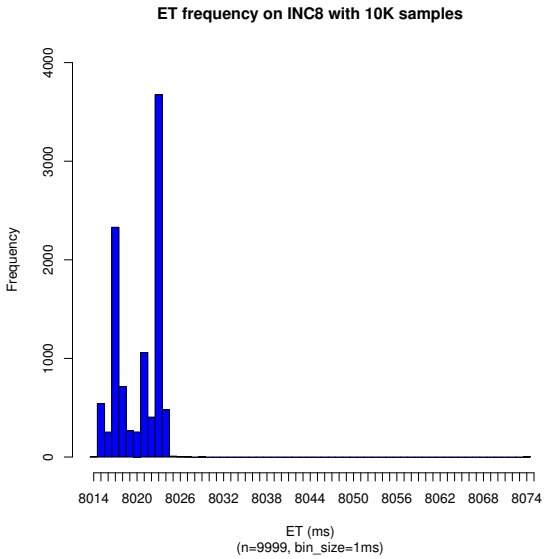
Table 3: Daemons observed from the INC8 run

5 Histograms with 10,000 samples

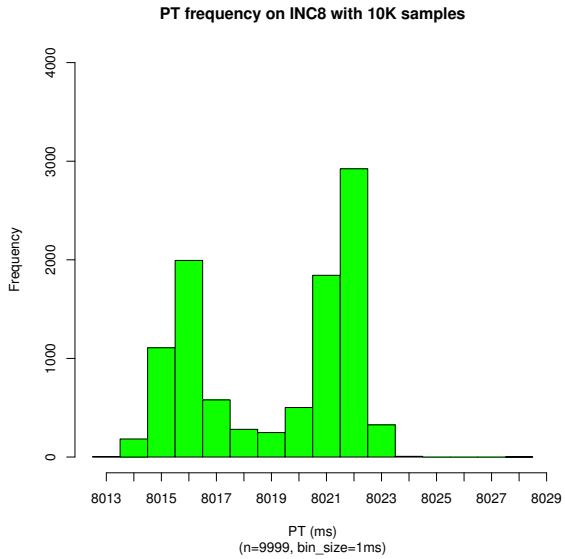
This section exhibits histograms on two runs of INC, each with 8 and 16 seconds as its task length, having 10,000 repetitions. The detailed description of the base data is from Table 4.

Machine	Task Length (sec)	Description	Experiment Period	Relevant Histograms
`sodb9`	INC8	10000 samples	2017-03-29 $\sim$ 2017-03-30	Figs. 17(a) and 17(b)
`sodb10`	INC16	10000 samples	2017-03-29$\sim$ 2017-03-31	Figs. 17(c) and 17(d)

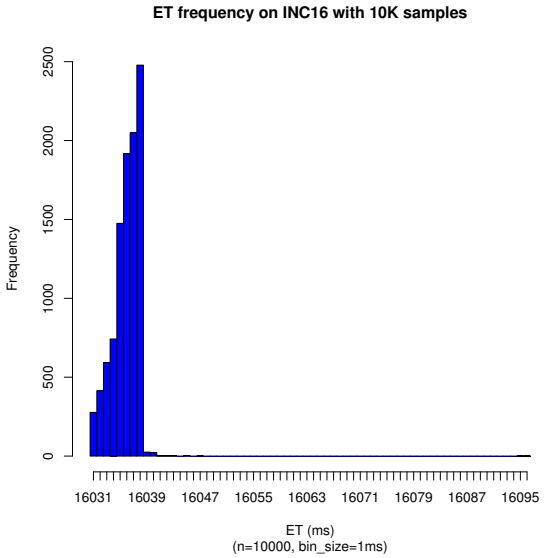
Table 4: Notes on experiment runs used for histograms



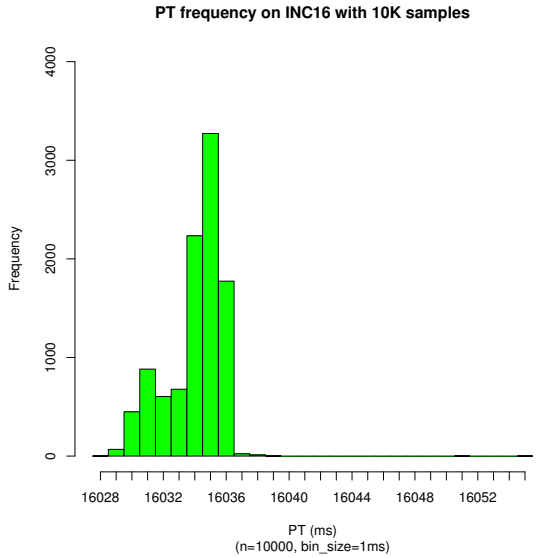
(a) ET frequency on INC8



(b) PT frequency on INC8



(c) ET frequency on INC16



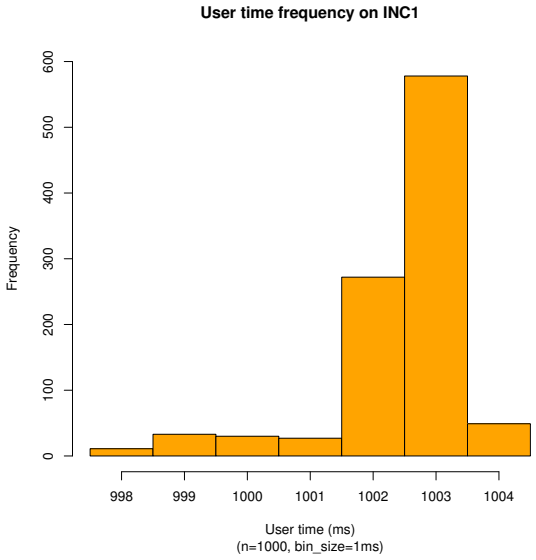
(d) PT frequency on INC16

Figure 17: Histograms of INC8 and INC16 with 10,000 samples

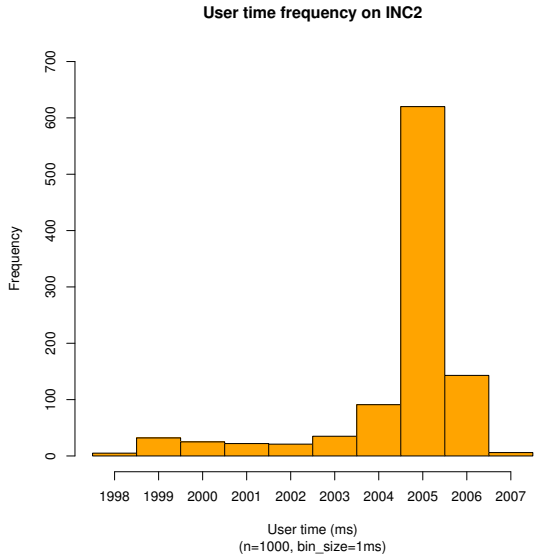
6 User and System Time Histograms on the Second Run

This section exhibits user and system time histograms on the second run of INC with its task length increasing from 1 second to 4096 seconds, via SEDONA. The detailed description of the base data is from Table 2.

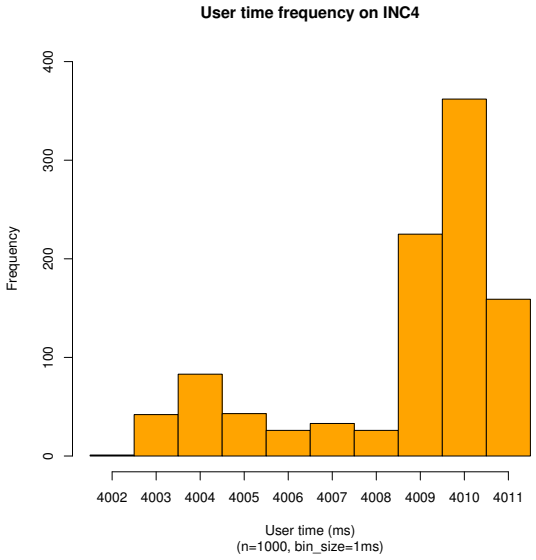
6.1 User Time



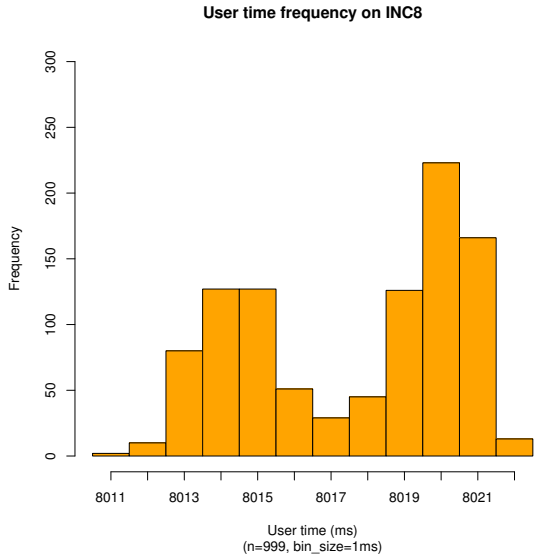
(a) User time frequency on INC1



(b) User time frequency on INC2

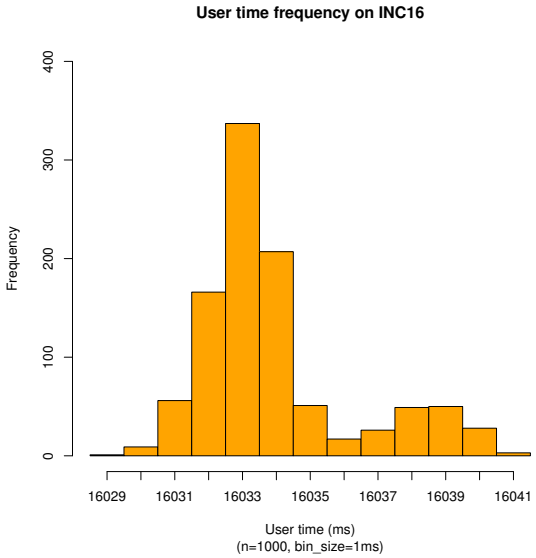


(c) User time frequency on INC4

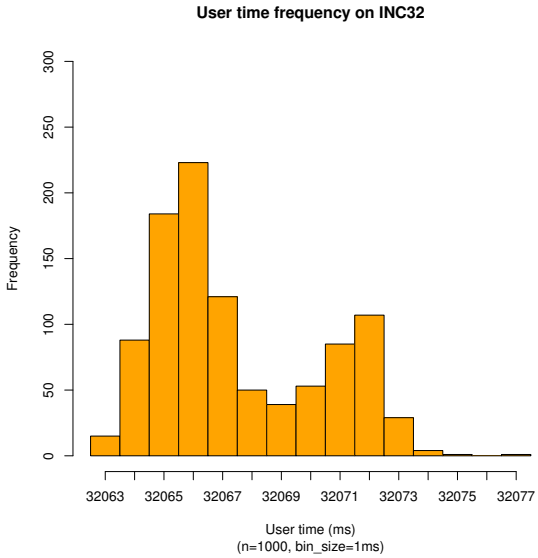


(d) User time frequency on INC8

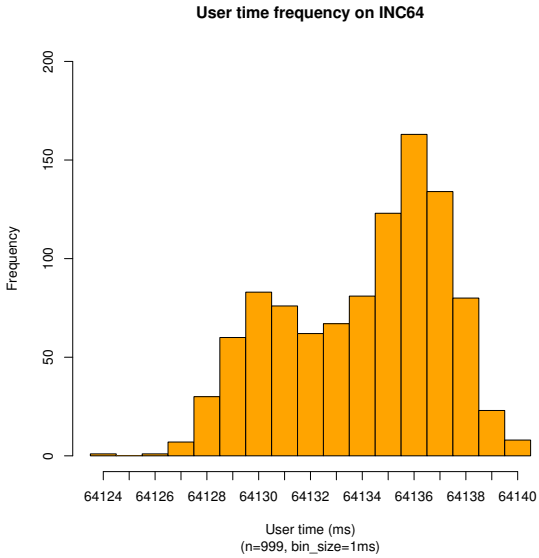
Figure 18: User Time Histograms of INC1 ... INC8



(a) User time frequency on INC16

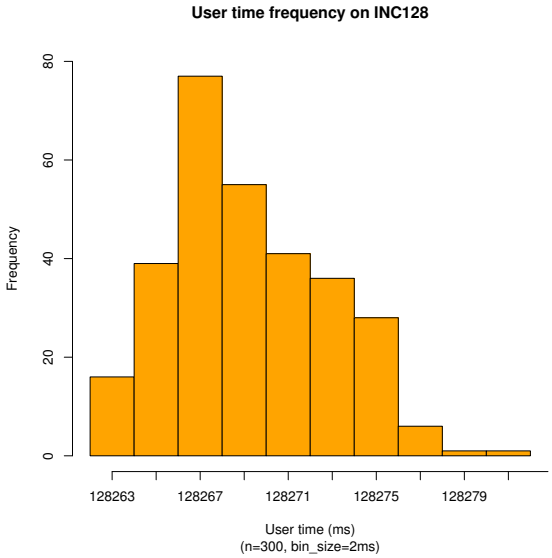


(b) User time frequency on INC32

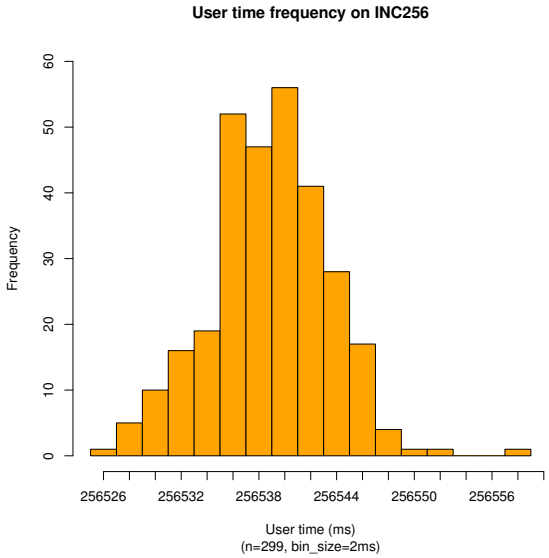


(c) User time frequency on INC64

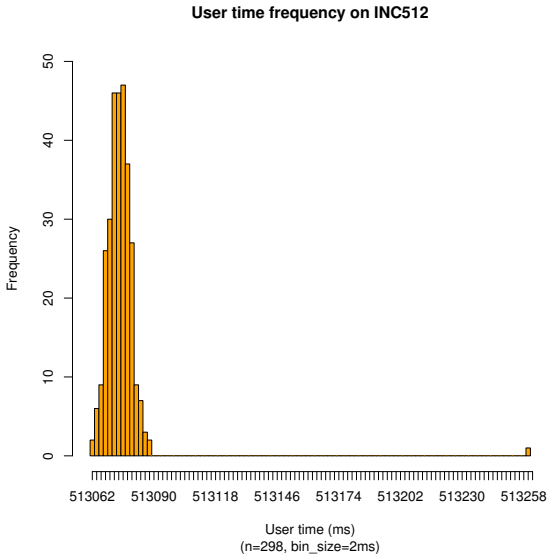
Figure 19: User Time Histograms of INC16 ... INC64



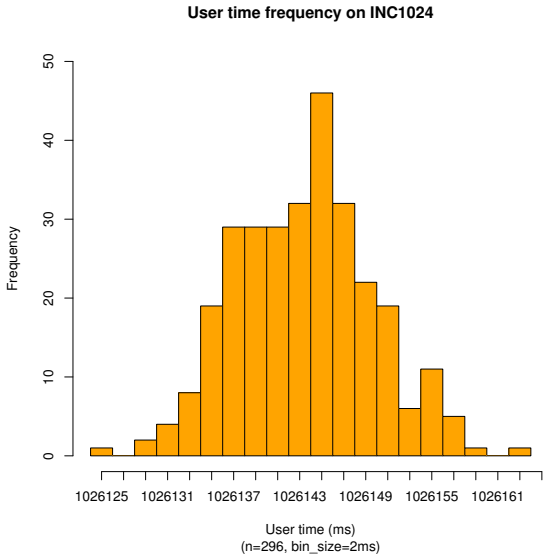
(a) User time frequency on INC128



(b) User time frequency on INC256

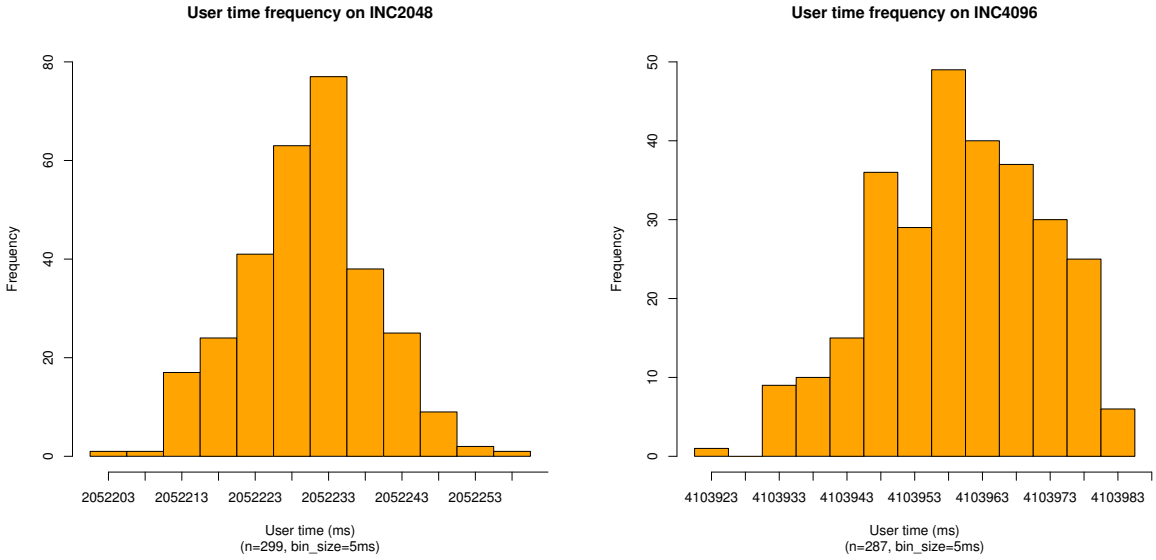


(c) User time frequency on INC512



(d) User time frequency on INC1024

Figure 20: User Time Histograms of INC128 ... INC1024

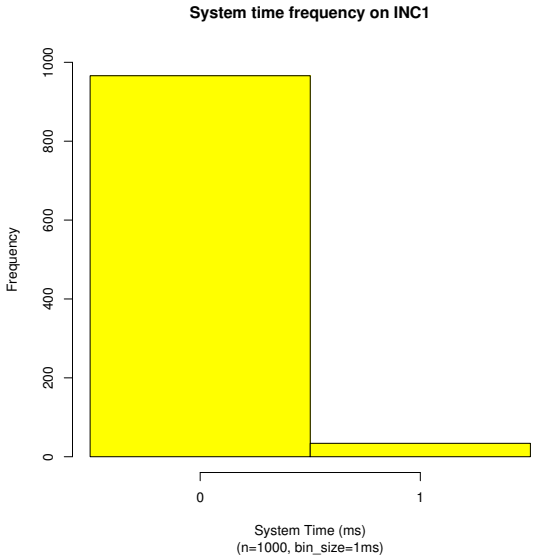


(a) User time frequency on INC2048

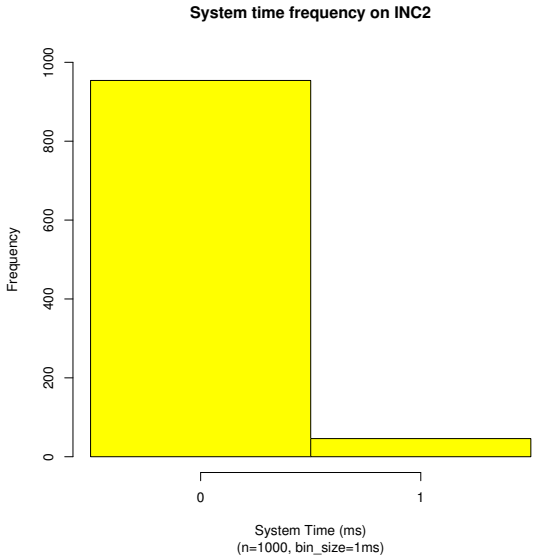
(b) User time frequency on INC4096

Figure 21: User Time Histograms of INC2048 and INC4096

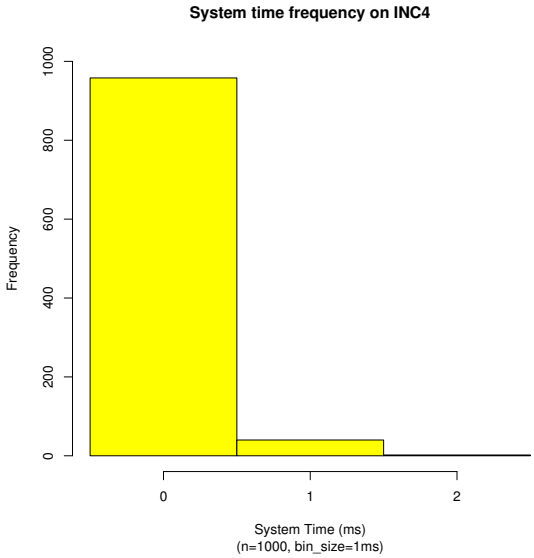
6.2 System Time



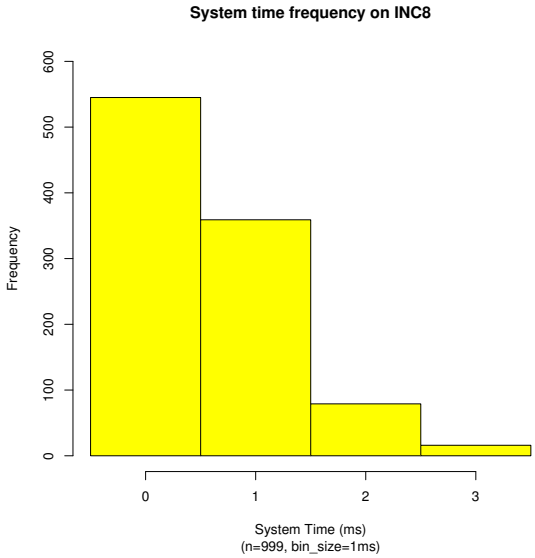
(a) System time frequency on INC1



(b) System time frequency on INC2

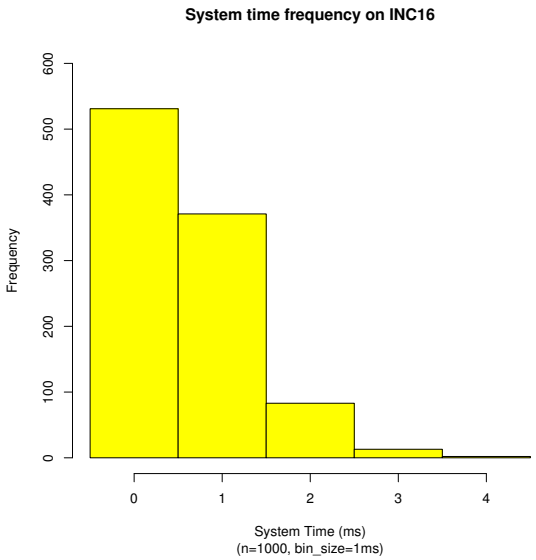


(c) System time frequency on INC4

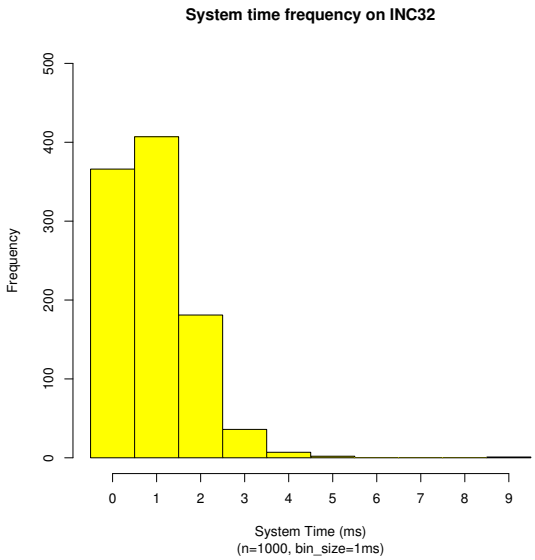


(d) System time frequency on INC8

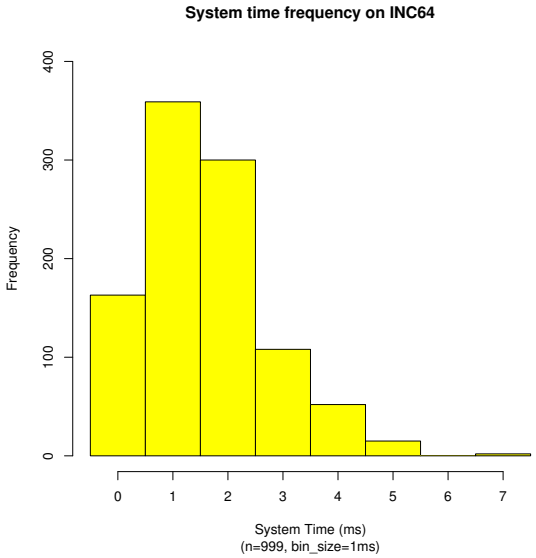
Figure 22: System Time Histograms of INC1 ... INC8



(a) System time frequency on INC16

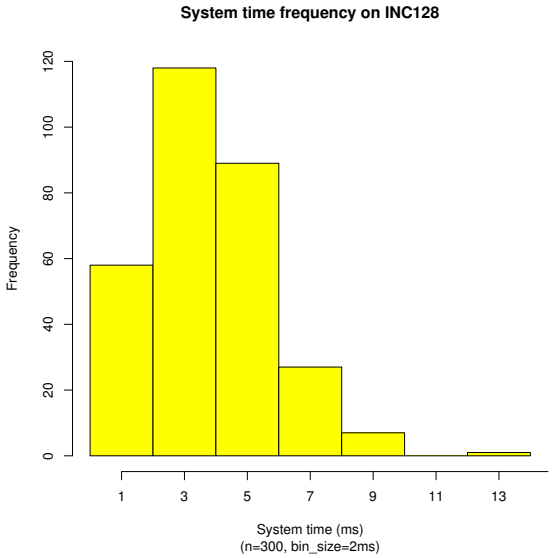


(b) System time frequency on INC32

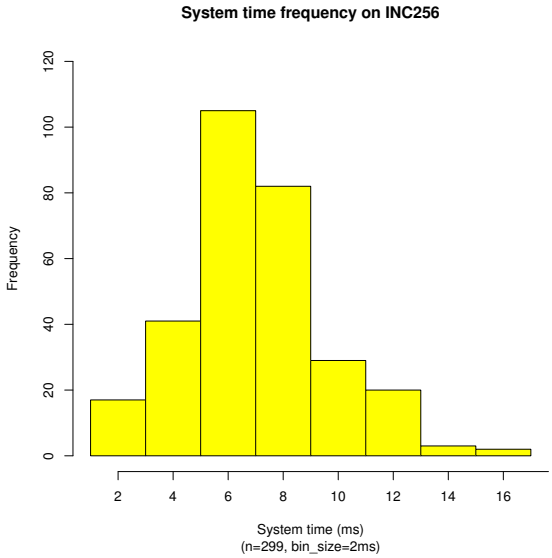


(c) System time frequency on INC64

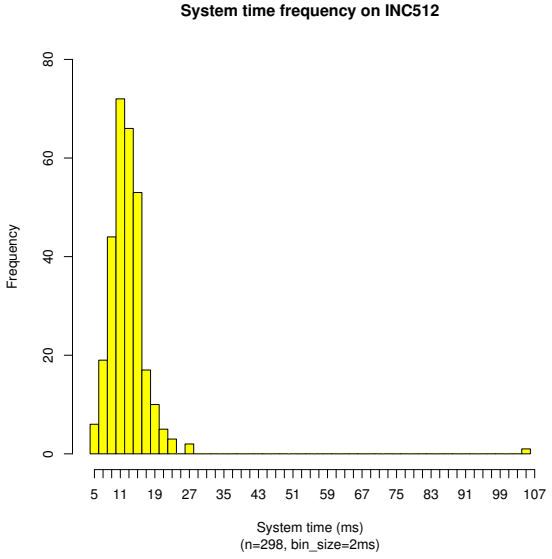
Figure 23: System Time Histograms of INC16 ... INC64



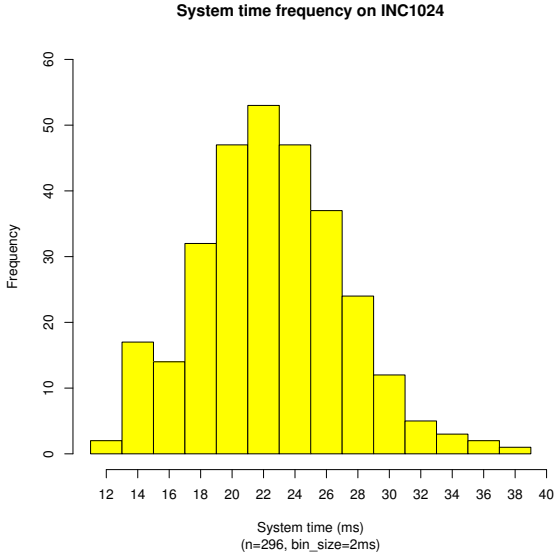
(a) System time frequency on INC128



(b) System time frequency on INC256

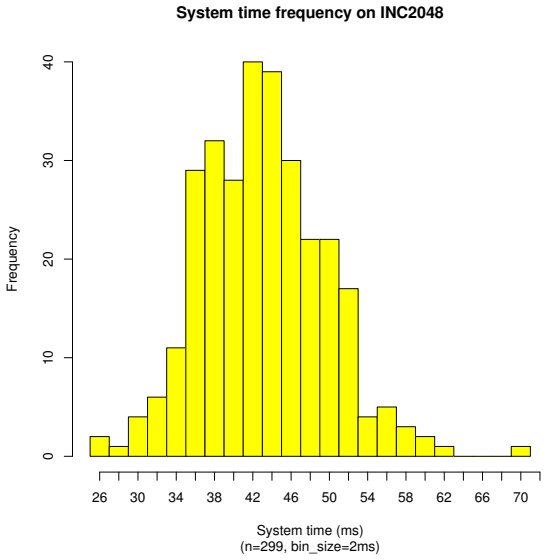


(c) System time frequency on INC512

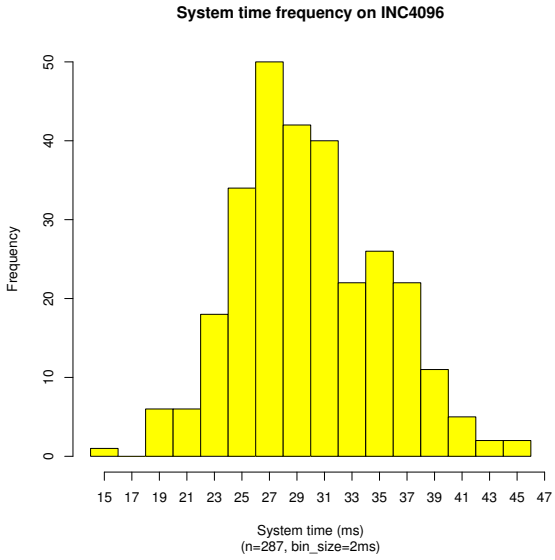


(d) System time frequency on INC1024

Figure 24: System Time Histograms of INC256 ... INC1024



(a) System time frequency on INC2048



(b) System time frequency on INC4096

Figure 25: System Time Histograms of INC2048 and INC4096