

Balancing Cage Husbandry Duties Among Animal Technicians

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The Current State

- 9,500 cage census of mostly rodents
- 8,500 cages with RFID cage cards scanned daily via fixed reader
- Resource assignments (e.g. biweekly cage/rack change schedules, food and bedding distribution, set ups, etc.) based on weekly snapshots of census.
- Census drives decision-making
 - Including workloads.



The Lightbulb



- We realized that revenue generation aside, RFID scans throughout the day might be able to tell us something novel about what is happening in rooms.
- We should be able to see how census is changing through the day.
- Indeed, we should be able to see the total number of cages that completely leave a facility, and the brand new cages created in it.

The Lightbulb



- Daily census measures the net effect of these changes.
- But suppose you had two rooms with identical censuses. One had 10 cages lost and 10 cages gained. While the other lost 5 cages and gained 5. Both would have the same net change census, 0.
- But surely the -10/10 room is different from the -5/5 room, presumably in terms of technician workload.

Putting it Together – Churn Rate

- If we combine the number of cages that completely leave a room with the newly created cages, we can measure something else about the room:
 - How active it is.
- We call this number the churn rate.
- By using the data from the RFID system at the beginning of the day and at the end*, we can determine what this churn rate per room per day is.



How to Test the Hypothesis

Methodology in Excel



Methodology – The Logical Assumptions

- Every two hours, we receive a report (AutoCensusDetails).
- It's a list of RFID tag codes, with a room number and a time stamp.
- If I compare the first report with the last report, I can learn which tags left the facility and which newly entered it.

RFID
AAAAC0010015120700003479
AAAAC0010017072500000134
AAAAC0010017032900000257
AAAAC0010017032900000258
AAAAC0010017032900000259
AAAAC0010017032900000264
AAAAC0010017032900000266
AAAAC0010017032900000320
AAAAC0010017032900000328
AAAAC0010017032900000330
AAAAC0010017032900000346
AAAAC0010015120700003487
AAAAC0010017030200000327
AAAAC0010017051500000004
AAAAC0010017032900000265
AAAAC0010017032900000324
AAAAC0010017032900000331
AAAAC0010015120700003340
AAAAC0010015120700003363
AAAAC0010015120700003370



A Caveat or Two

- We could only analyze the rooms with fixed readers.
 - That leaves out about 1,000 cages.
- We won't see cages transferred between rooms in this analysis.
 - Only rooms that completely leave the facility, and those newly created.
- There are more tasks done in a room than loss or gain of cages.
 - Health monitoring
 - Consumables
 - Housekeeping
- In effect, this measures additional burden created by this cage turnover.



An Example Using MATCH()

- Given we have about 8,500 individual RFID tags to compare, we need an efficient method to do so.
 - Enter MATCH(), which allows us to see whether any of the tags are in both lists.
- Let's look at a simple example using the alphabet.



An Example Using MATCH()

List 1	Match?	List 2
A		B
B		A
C		F
D		C
E		D
F		G



An Example Using MATCH()

List 1	Match?	List 2
A	2	B
B	1	A
C	4	F
D	5	C
E	#N/A	D
F	3	G



MATCH() Needs Something Else – ISNA()

- MATCH() tells us if there is a match and where in the list the match occurs. But we're interested in the non-matches, the “#N/A” in the previous example.
 - I want a way to easily pivot the non-matches.
- Enter ISNA()
- With a little fancy Excel wizardry involving IF(), I can now isolate just the non-matches.



An Example Using MATCH()

List 1	Match?	List 2
A	0	B
B	0	A
C	0	F
D	0	C
E	1	D
F	0	G



An Easy Pivot

Row Labels	Sum of Losses	Row Labels	Count of RFID2	Sum of Gains	Churn
328.11	8	328.11	50	0	8
328.13	0	328.13	143	1	1
328.15	0	328.15	151	0	0
328.30	2	328.30	41	8	10
A1102	0	A1102	47	0	0
A1111	1	A1111	285	7	8
A1114	1	A1114	285	4	5
A1202	22	A1202	264	1	23
A1209	0	A1209	379	2	2
A1214	5	A1214	451	2	7
A1303	10	A1303	387	2	12
A1305	11	A1305	337	28	39
A1306	0	A1306	182	1	1
A1309	0	A1309	245	2	2
A1403	0	A1403	399	2	2
A1404	1	A1404	16	6	7



Data Organization/Analysis

Room ▼	12/24/2017 ▼	12/25/2017 ▼	12/26/2017 ▼	12/27/2017 ▼	12/28/2017 ▼	12/29/2017 ▼	12/30/2017 ▼
328.11	3	0	3	2	5	0	0
328.13	0	1	0	2	0	0	0
328.15	0	1	3	10	7	2	0
328.30	1	0	1	0	0	0	0
A1102	0	0	9	1	1	1	0
A1111	0	1	0	0	0	2	0
A1114	0	2	16	22	0	0	0
A1202	3	1	2	3	4	1	2
A1209	0	0	4	1	0	0	0
A1214	1	2	2	3	7	3	0
A1303	0	0	2	2	9	10	0
A1305	44	29	40	50	44	53	26
A1306	0	0	0	1	0	0	0
A1309	3	3	1	3	0	5	0
A1403	3	0	0	4	0	3	0
A1404	1	0	3	0	4	2	1



What To Do With What We Have

A Call To (Management) Action



Three Cases

- A1708 – Examples of high churn rate coincides with technicians' anecdotal impression of room's workload.
- Northwest Building – Stable census, low churn rate; 33% of cage wash resources allocated solely to building twice a week.
- A1305 – Very high churn rates, but technician not seeing any higher workload, dirty cage production, etc.



The A1708 Case

- The census at the beginning of this period was 393 and ended at 425.
 - A net change of 32 cages.
- Technicians (anecdotally) report it is a “busy” room with a lot of activity.
- Reliance purely on weekly change in census suggests it’s not that busy.
 - Week 1 beginning census: 393
 - Week 2 beginning census: 403
 - Week 3 beginning census: 424

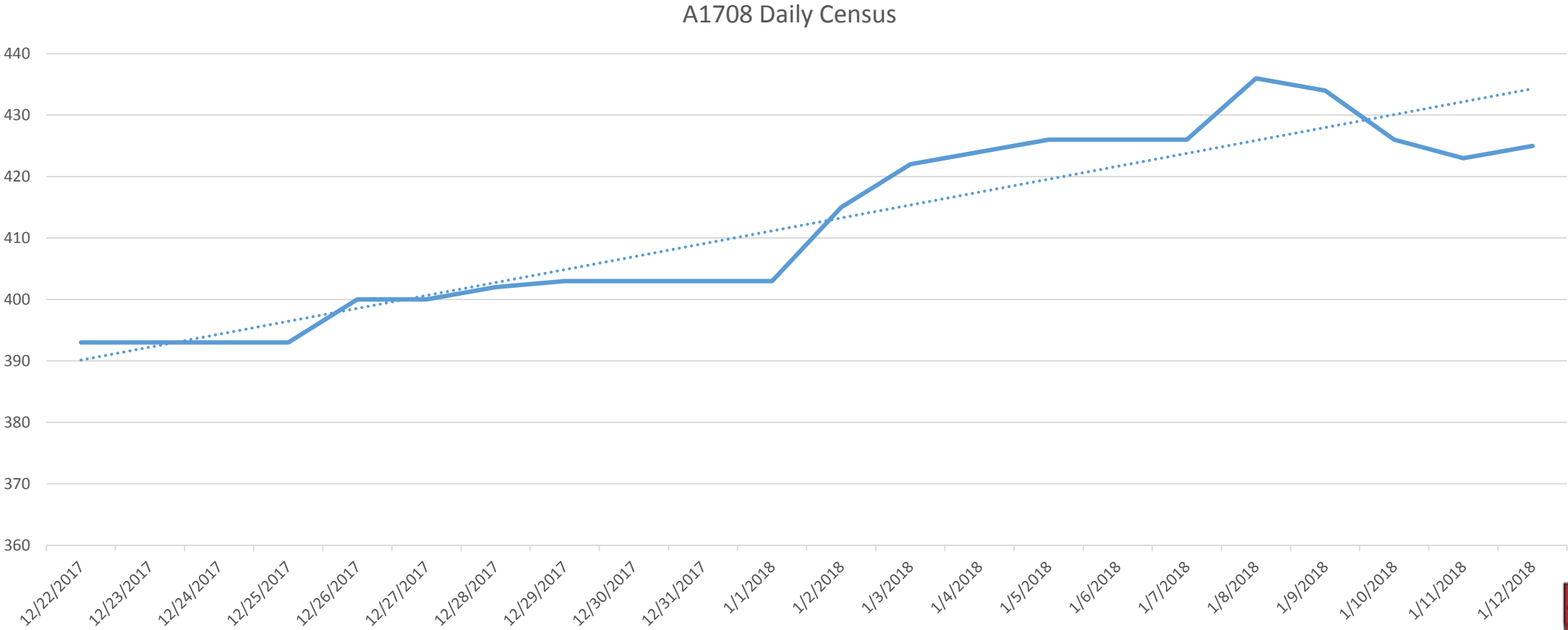


The A1708 Case

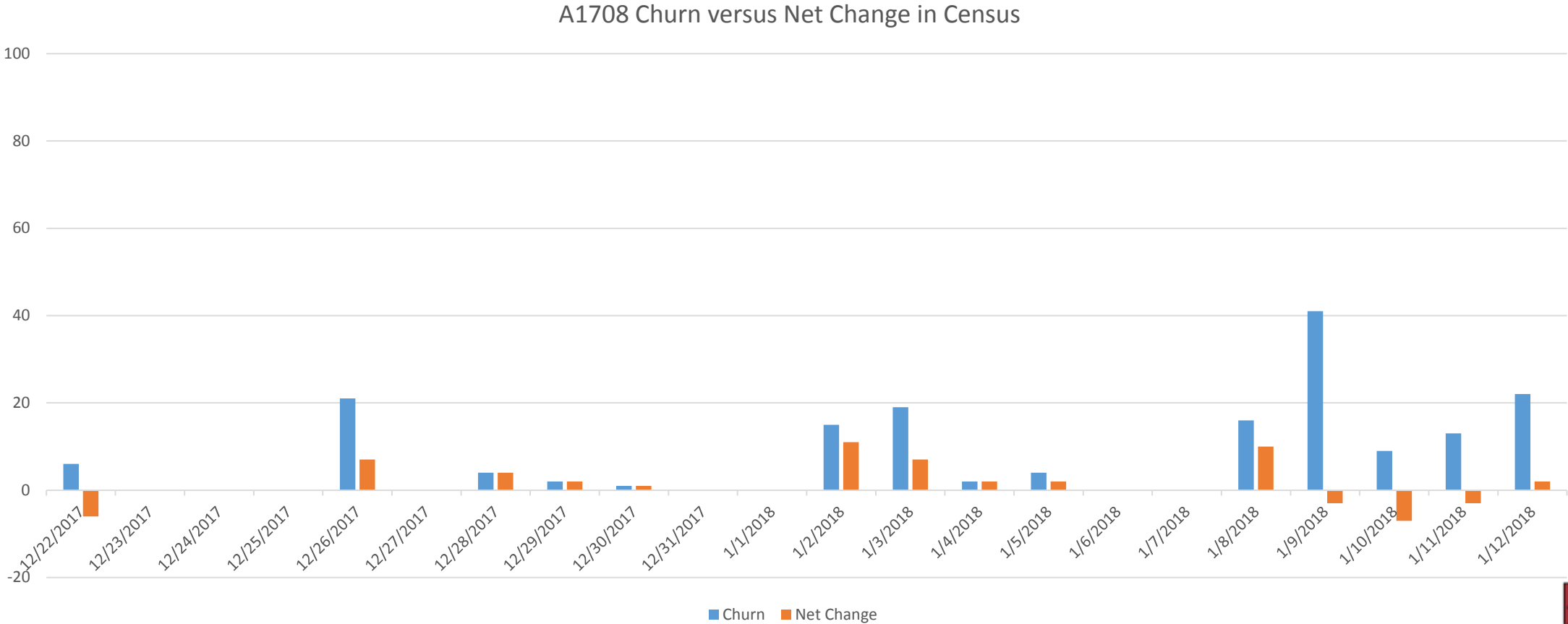
- Can data (i.e. churn rates) help tease this out?



The A1708 Cases

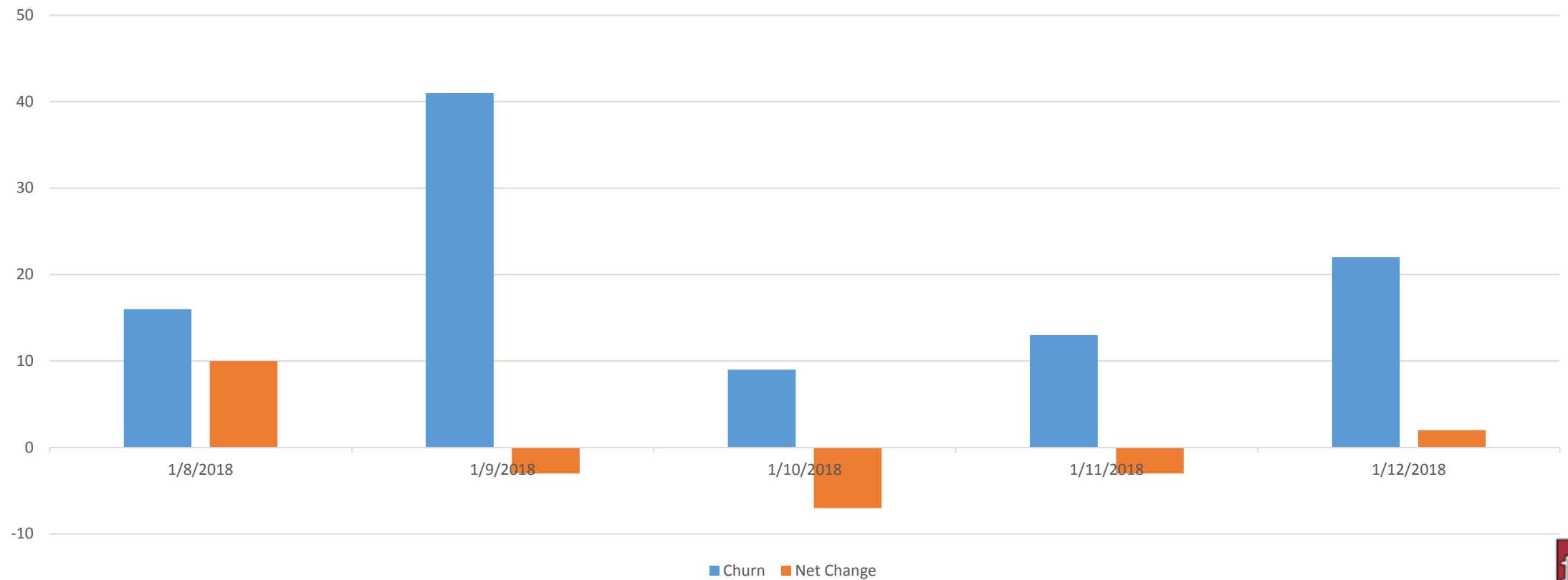


The A1708 Case



The A1708 Case

A1708 Churn versus Net Change in Census



The A1708 Case

- The data do seem to show that, particularly once the researchers returned from the intersession, activity in the room was much higher than either raw census or the net change in census would indicate.
- To make things more equitable, management could insure (using this tool) that high churn dates call for more resources assigned to this room.



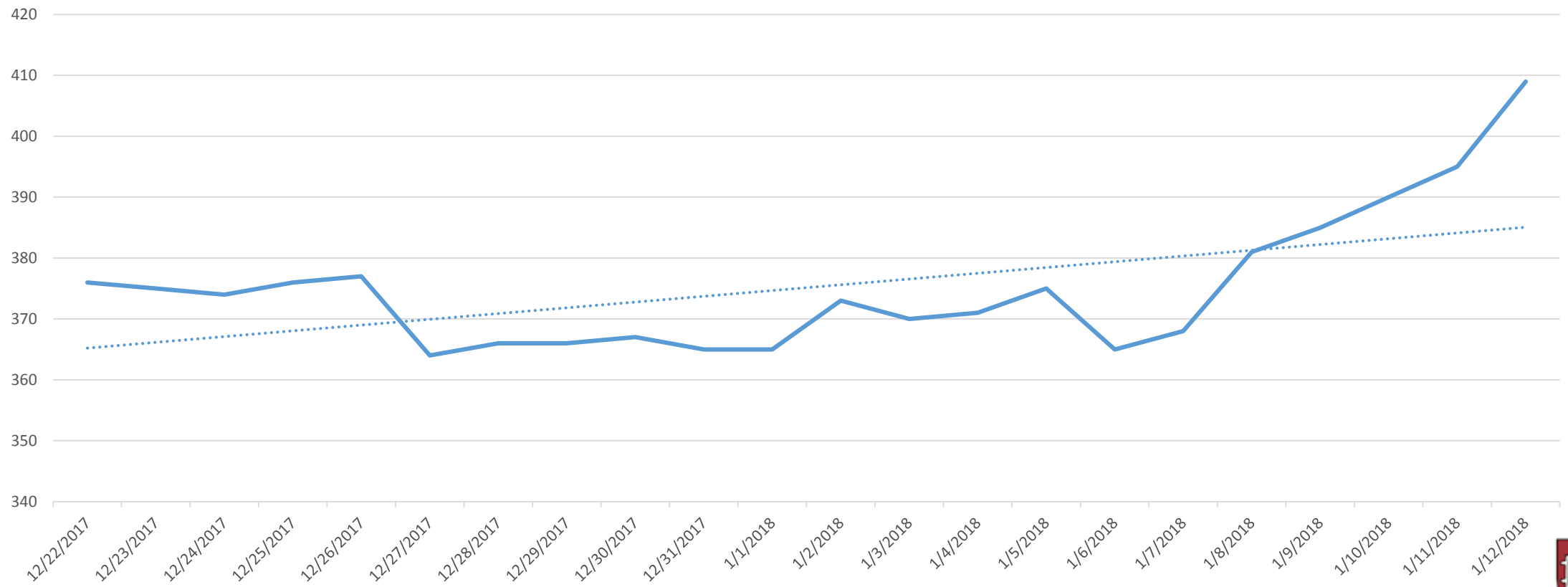
Northwest Building

- The whole facility has a census profile similar to one room in our BRI (Biological Research Infrastructure).
 - We'll see this in terms of census, churn rates, and net change in census
- And yet, we allocate one third of cage wash resources to the facility twice a week.
- What do the data suggest about the turnover of cages that might help us allocate those resources in a smarter, more equitable way?



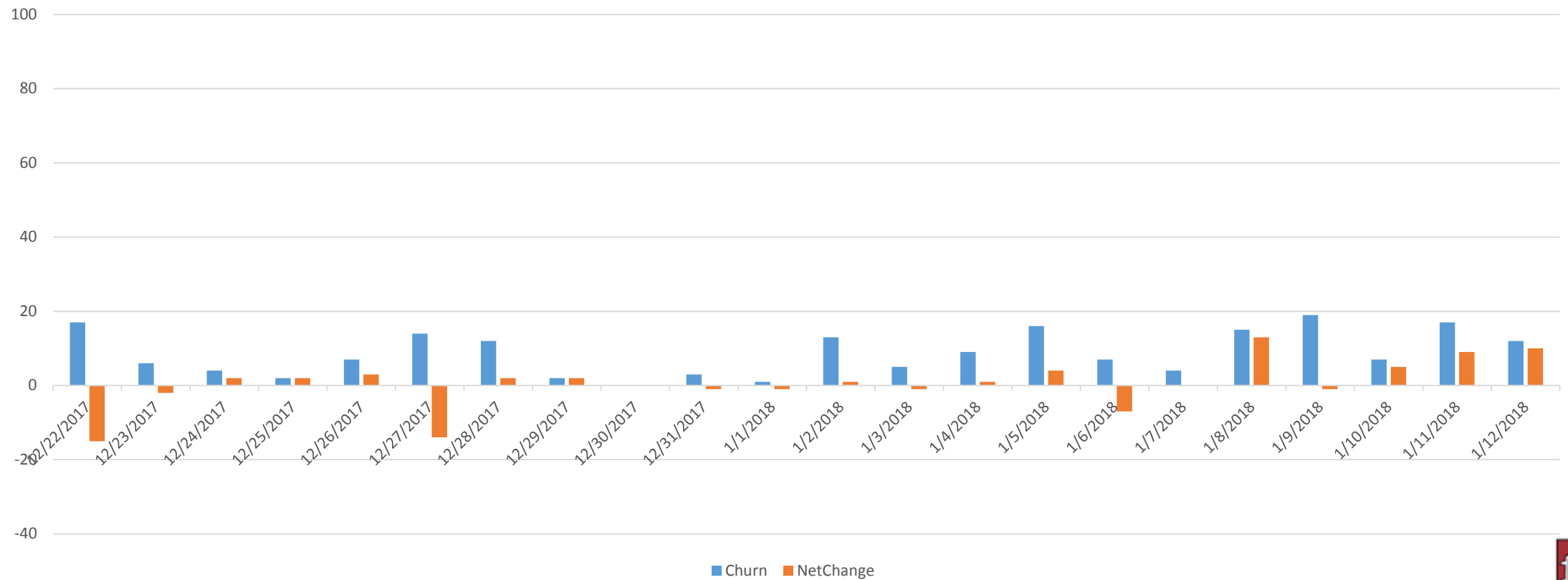
Northwest Building

NWB Census



Northwest Building

NWB Churn versus Net Change in Census



Northwest Building

- Activity seems to be spread out, rather than concentrated in a few days.
- Perhaps Management should consider spreading out the allocation of Cage Wash resources over the whole week.
- An important caveat to remember is that this metric does not measure the regularly scheduled cage changes in each room. What it does measure is the additional burden.

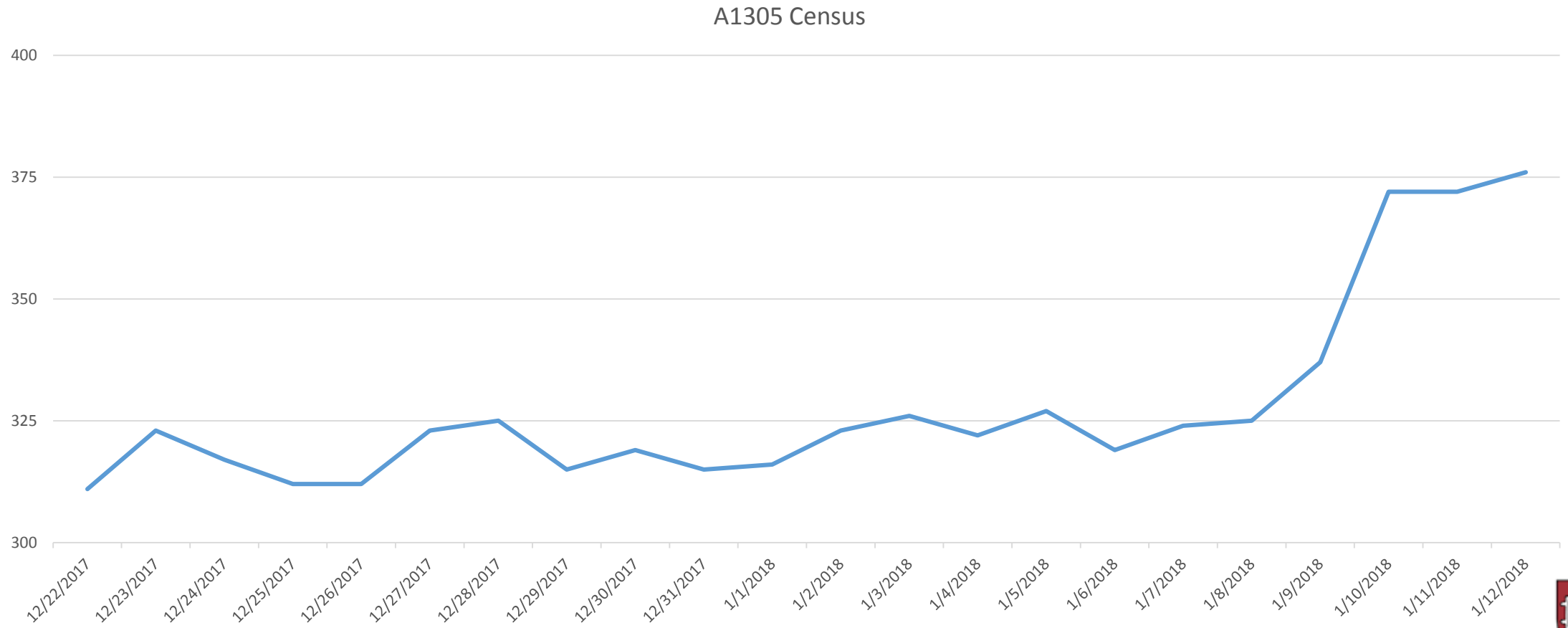


A1305 – The Anomaly

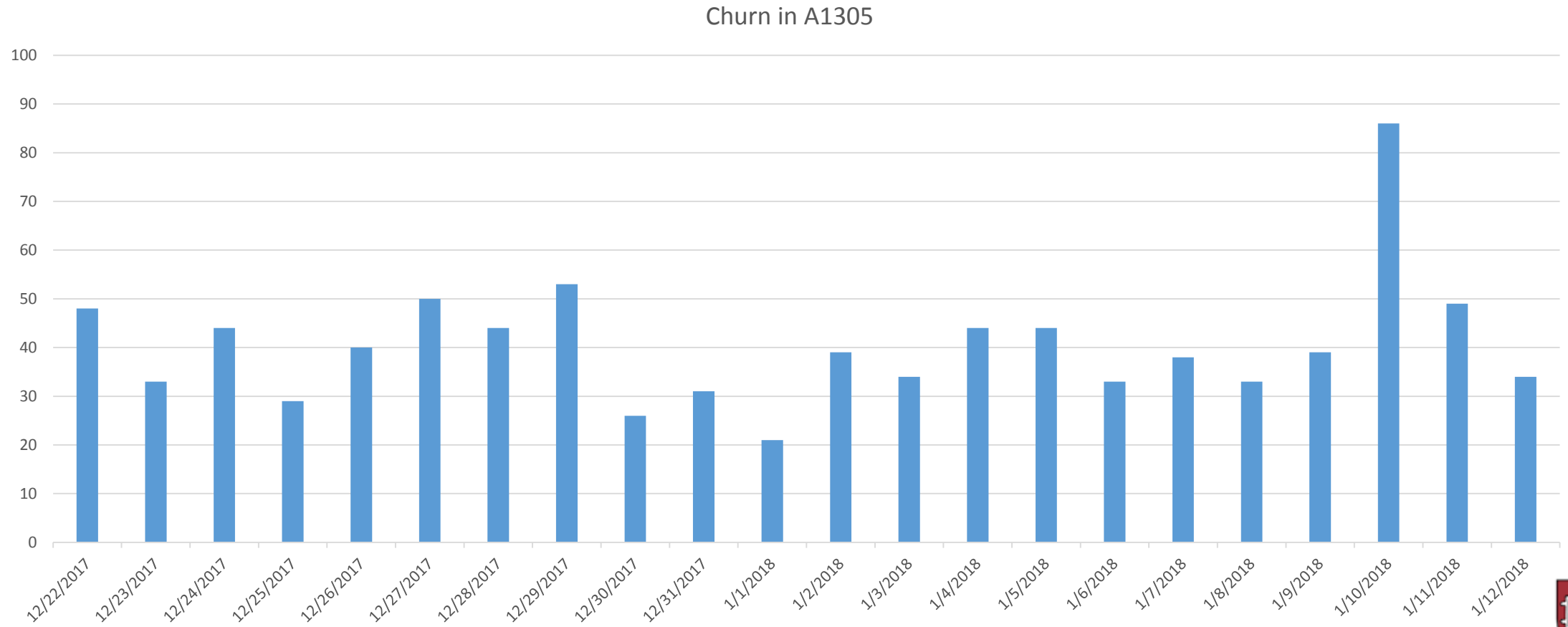
- When we looked at the data, A1305 was always the highest room in terms of churn except on 3 occasions, and even then it was not far behind the leader.
- But net change in census was very low.
- The room technician reported the workload in the room wasn't any higher than his other rooms, and he didn't notice a lot of cages created or used.



A1305 – The Anomaly



A1305 – The Anomaly

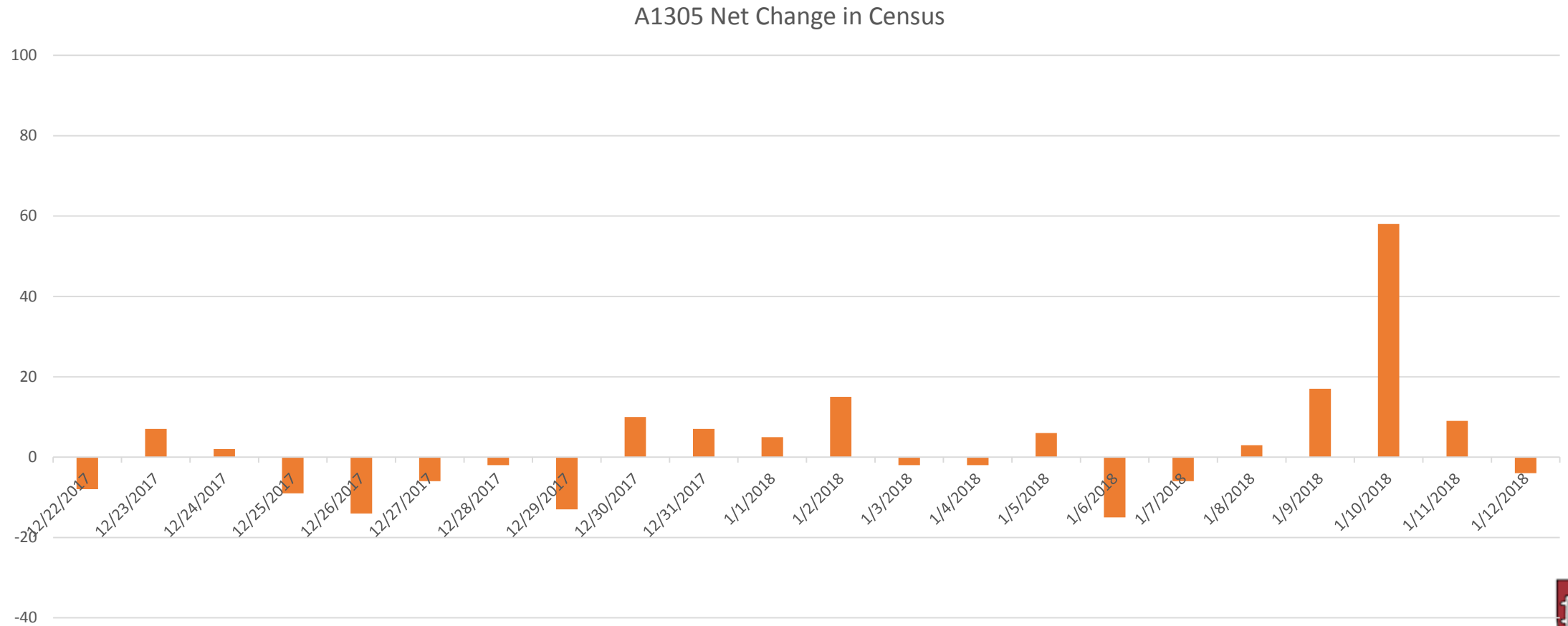


A1305 – The Anamoly

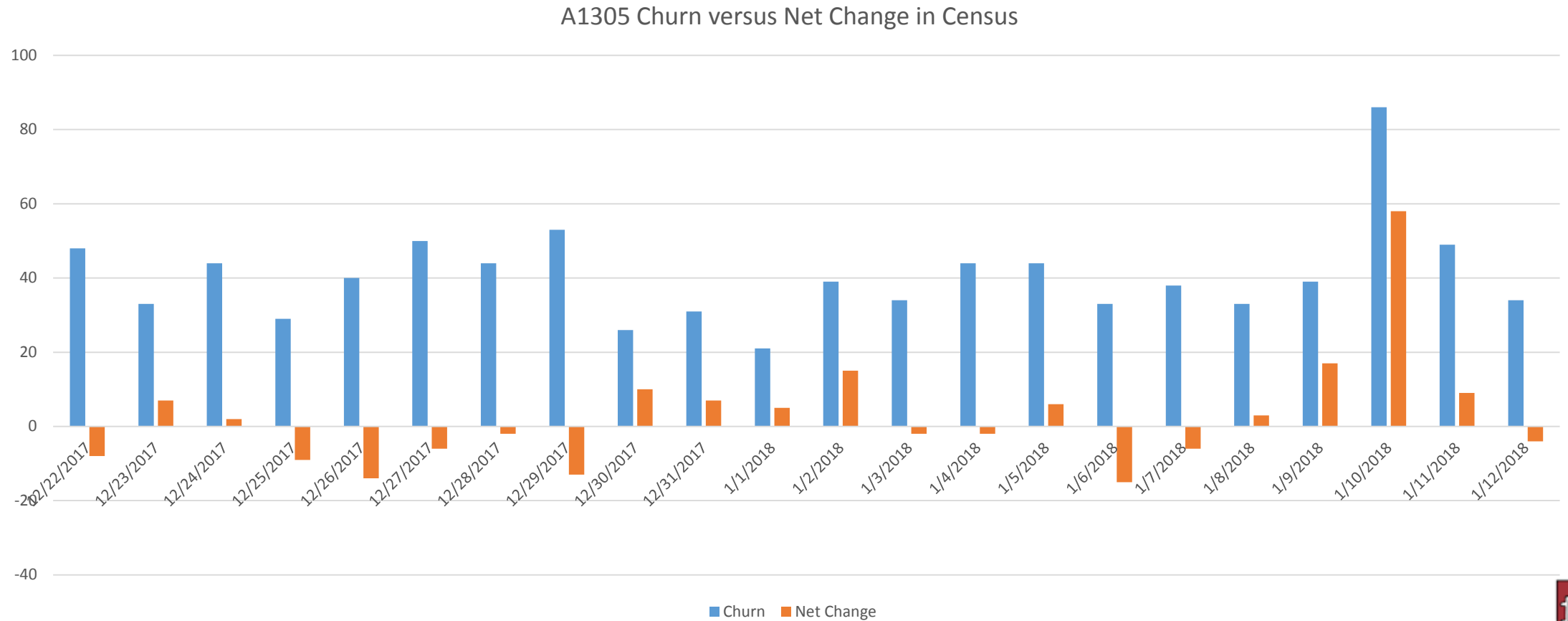
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A1114	0	2	16	22	0	0	0
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A1309	3	3	1	3	0	5	0
A1403	3	0	0	4	0	3	0
A1404	1	0	3	0	4	2	1



A1305 – The Anomaly



A1305 – The Anomaly



A1305 – The Reality Check

- This room appears from the data to be a very busy room.
- It also seems to illustrate that churn rate could indicate more than raw census or net change in census
- But the technician in the room reported just the opposite
 - Not any more work than any of his other rooms.
 - He doesn't see a lot of dirty cages and doesn't need to provide a lot of clean setups.
 - The labs in this room do not appear to be disproportionately drawing down our supply of preprinted cage cards.



A1305 – The Mystery

- The lab appears to take our process very seriously (i.e. “every newly created cage gets its own, new RFID cage card”), but also seems to be reusing some cards.
 - More work to be done to lock this down.
- Still, one of our Supervisors noted that while this might not have an impact on Animal Care staff, the work the labs are doing in that room is probably on Vet Services’ radar.
- Moreover, since we don’t (yet) track how many dirty cages leave a room, it is possible these high churn rates also have an effect on Cage Wash resources. Thus, it isn’t just enough to consider equitable distribution of Animal Care staff resources, but Vet Staff and Cage Wash too.



The Conclusion



What Did We Learn

- The data appear to be useful for corroborating anecdotal reports of high activity for certain rooms.
- The idea was to be able to make resource allocation more equitable.
- Churn provides an additional tool to accomplish that while also providing us with more questions.
- It isn't just enough to consider equitable distribution of Animal Care staff resources, but Vet Staff and Cage Wash too.



The Next Step

- Churn is only one tool. So in order to make this tool richer and decision-making smarter, we need a suite of tools that help illuminate the work.
- One idea is to measure other metrics churn does not measure, like how often are food, cage-based forms, etc replenished.
- These can, along with churn, and cage change schedules, all be layered together to determine what the busiest days are, what are the busyness drivers, and how then to allocate resources from the least busy rooms to the busy rooms.



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Impact Summary

Title: **Balancing Cage Husbandry Duties Among Animal Technicians** Problem and analysis
method: Using Excel to measure the “busyness” of rooms from RFID data

Summary: The churn rate can be one of many valuable tools to make smarter choices about resource allocation for animal care technicians, cage way, veterinary care staff, etc.



Impact of the analytics study

Decisions made/Actions Taken: This tool should be incorporated with other tools to help understand drivers of additional activity (i.e. busyness) in rooms so as to allocate resources better. But more work at Harvard is still necessary.