

Technical Analysis Sample:  
CO<sub>2</sub> Concentration In Library Study Room

Rebecca Burke  
10.28.2016

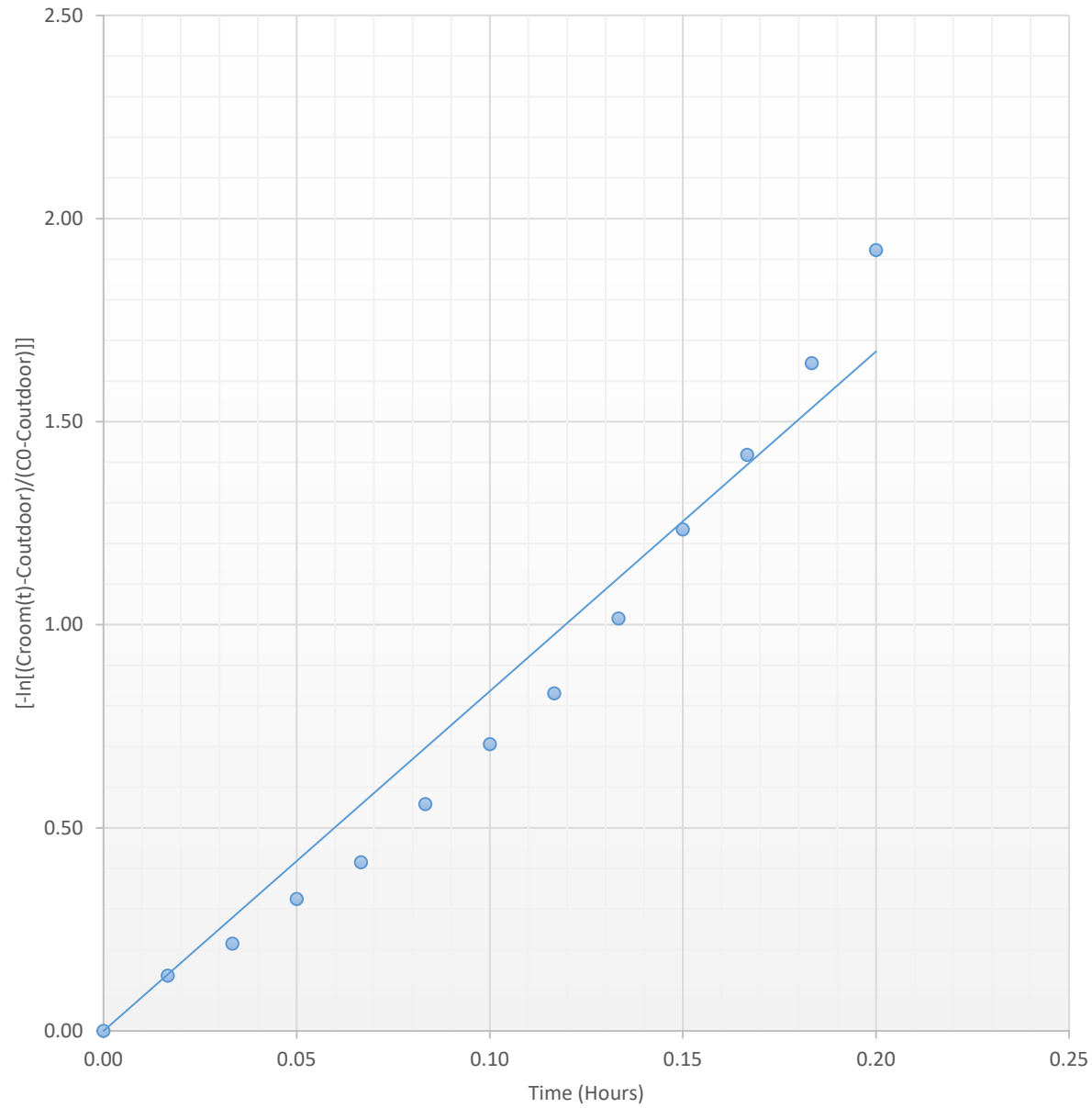
Rebecca Burke  
 ENGR 115  
 8:00  
 10/28/2016

Input Parameters:	
Measured C <sub>OUTDOOR</sub> [ppm]	554
Assumed C <sub>OUTDOOR</sub> [ppm]	400
Correction Factor	-154
Room Volume [ft <sup>3</sup> ]	1080
Room Capacity [people]	7

Calculations:	
Air Exchange Rate [1/hr]	8.36
Time to remove non-reactive chemical [hr].119	0.36
Ventilation Rate [ft <sup>3</sup> /min/person]	21.5

Analysis						
Measurement (min Intervals)	Date & Time	HOBO CO2 Concentration	Actual CO2 Concentration	Hours	[-ln((Croom(t)-Coutdoor)/(C0-Coutdoor))]	
0	10/21/2016 9:52	879	725	0.000	0.000	
1	10/21/2016 9:53	838	684	0.017	0.136	
2	10/21/2016 9:54	816	663	0.033	0.215	
3	10/21/2016 9:55	789	635	0.050	0.325	
4	10/21/2016 9:56	769	615	0.067	0.415	
5	10/21/2016 9:57	740	586	0.083	0.558	
6	10/21/2016 9:58	714	561	0.100	0.706	
7	10/21/2016 9:59	695	542	0.117	0.831	
8	10/21/2016 10:00	672	518	0.133	1.015	
9	10/21/2016 10:01	648	495	0.150	1.234	
10	10/21/2016 10:02	633	479	0.167	1.418	
11	10/21/2016 10:03	617	463	0.183	1.644	
12	10/21/2016 10:04	601	448	0.200	1.922	

Air Exchange Rate Analysis Plot



$y = 8.3636x$   
 $R^2 = 0.9606$

- [-ln[(Croom(t)-Coutdoor)/(C0-Coutdoor)]]
- Linear ([-ln[(Croom(t)-Coutdoor)/(C0-Coutdoor)]])

**Lab Questions****What is the air exchange rate ( $\lambda$ ) of the room you tested?**The air exchange rate ( $\lambda$ ) of the room we tested was 8.36/hour.**Compare your ventilation rate for a typical number of occupants to the ASHRAE recommended ventilation rate. Based on this comparison, are the occupants wasting energy heating and cooling the air or are the occupants being too cheap and not supplying enough air?**

To keep CO<sub>2</sub> concentrations at reasonable levels ASHRAE's recommended ventilation rate for classrooms is 15 scfm/person. However, according to ASHRAE.org *Ventilation for Acceptable Indoor Air Quality*, a table for educational spaces from 2003 shows an acceptable ventilation rate for a musical educational room (such as the one we were occupying) as 19 ft<sup>3</sup>/min/person. As our rate measured at 30.1 ft<sup>3</sup>/min/person, the ventilation rate is higher than it needs to be and occupants are wasting energy heating and cooling the air.

**Given the ASHRAE standard ventilation standard, what is the maximum number of people you would recommend having in this room at one time?**

Shown below by room capacity inputs, our Ventilation Rate is acceptable for up to 7 people. Once an input of room capacity of 8 is selected, our Ventilation Rate drops below the ASHRAE recommended ventilation rate.

Input Parameters:		Input Parameters:	
Measured C <sub>OUTDOOR</sub> [ppm]	554	Measured C <sub>OUTDOOR</sub> [ppm]	554
Assumed C <sub>OUTDOOR</sub> [ppm]	400	Assumed C <sub>OUTDOOR</sub> [ppm]	400
Correction Factor	-154	Correction Factor	-154
Room Volume [ft <sup>3</sup> ]	1080	Room Volume [ft <sup>3</sup> ]	1080
Room Capacity [people]	8	Room Capacity [people]	7
Calculations:		Calculations:	
Air Exchange Rate [1/hr]	8.364	Air Exchange Rate [1/hr]	8.364
Time to remove non-reactive chemical [hr].1196	0.359	Time to remove non-reactive chemical [hr].1196	0.359
Ventilation Rate [ft <sup>3</sup> /min/person]	18.8	Ventilation Rate [ft <sup>3</sup> /min/person]	21.5

Rebecca Burke  
 ENGR 115  
 8:00  
 10/21/2016

**Input Parameters:**

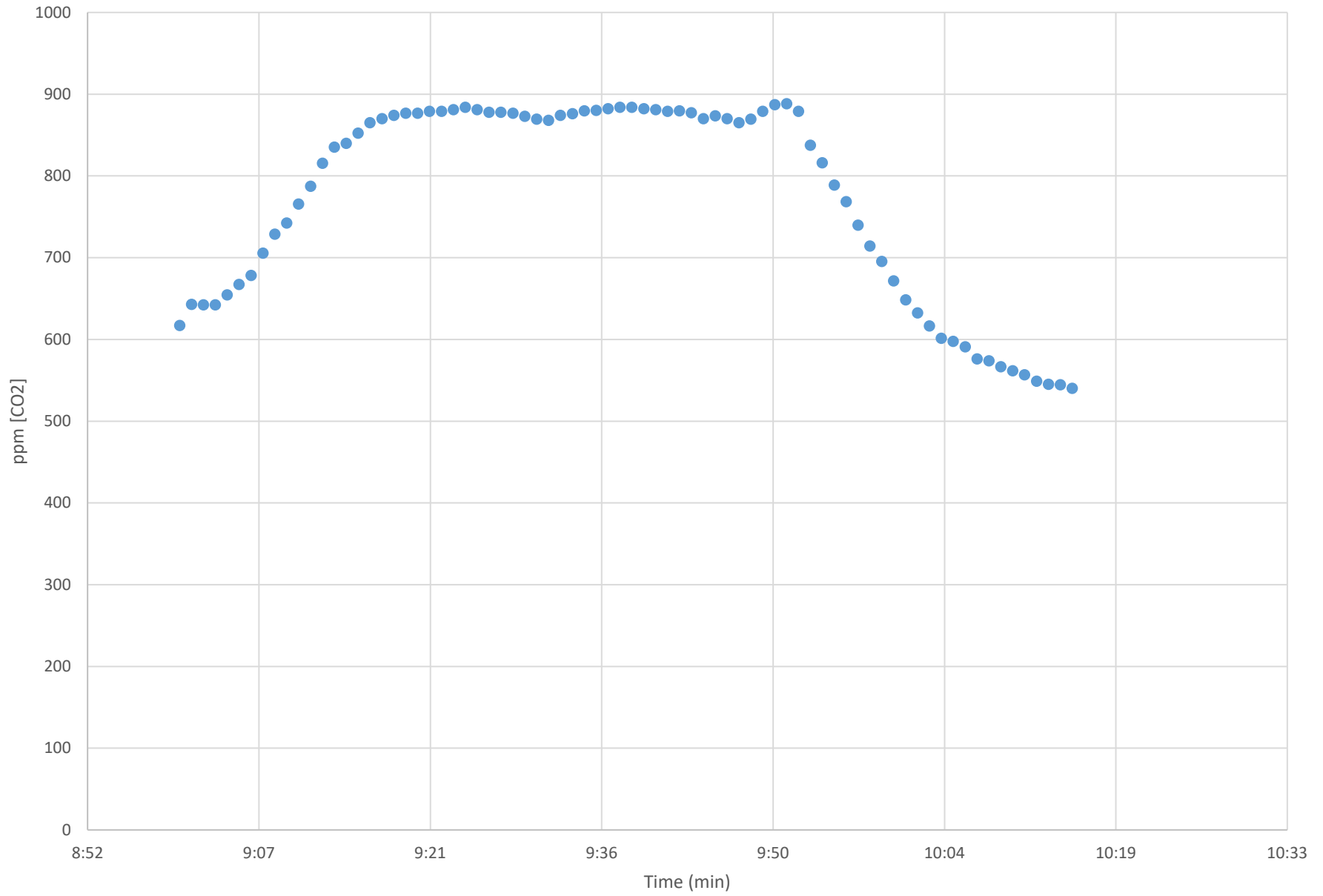
Measured  $C_{OUTDOOR}$  553.7  
 Assumed  $C_{OUTDOOR}$  400  
 Correction Factor -153.7

**Analysis**

Measurement (min Int)	Date & Time	Hours	HOBO CO2 Concentration	Actual CO2 Concentration	
1		9:00	0.000	617	464
2		9:01	0.017	643	489
3		9:02	0.033	642	489
4		9:03	0.050	642	489
5		9:04	0.067	655	501
6		9:05	0.083	667	514
7		9:06	0.100	678	525
8		9:07	0.117	706	552
9		9:08	0.133	729	575
10		9:09	0.150	742	589
11		9:10	0.167	766	612
12		9:11	0.183	788	634
13		9:12	0.200	816	662
14		9:13	0.217	835	682
15		9:14	0.233	840	686
16		9:15	0.250	852	699
17		9:16	0.267	865	711
18		9:17	0.283	870	716
19		9:18	0.300	874	721
20		9:19	0.317	877	723
21		9:20	0.333	877	723
22		9:21	0.350	879	725
23		9:22	0.367	879	725
24		9:23	0.383	881	727
25		9:24	0.400	884	730
26		9:25	0.417	881	727
27		9:26	0.433	878	724
28		9:27	0.450	878	724
29		9:28	0.467	877	723
30		9:29	0.483	873	719
31		9:30	0.500	869	716
32		9:31	0.517	868	714
33		9:32	0.533	874	721
34		9:33	0.550	876	722
35		9:34	0.567	880	726
36		9:35	0.583	880	727
37		9:36	0.600	882	729
38		9:37	0.617	884	730
39		9:38	0.633	884	730
40		9:39	0.650	882	729
41		9:40	0.667	881	727
42		9:41	0.683	879	725
43		9:42	0.700	880	726
44		9:43	0.717	877	724
45		9:44	0.733	870	716
46		9:45	0.750	874	720
47		9:46	0.767	870	716
48		9:47	0.783	865	711

49	9:48	0.800	869	716
50	9:49	0.817	879	725
51	9:50	0.833	887	733
52	9:51	0.850	888	735
53	9:52	0.867	879	725
54	9:53	0.883	838	684
55	9:54	0.900	816	663
56	9:55	0.917	789	635
57	9:56	0.933	769	615
58	9:57	0.950	740	586
59	9:58	0.967	714	561
60	9:59	0.983	695	542
61	10:00	1.000	672	518
62	10:01	1.017	648	495
63	10:02	1.033	633	479
64	10:03	1.050	617	463
65	10:04	1.067	601	448
66	10:05	1.083	598	444
67	10:06	1.100	591	437
68	10:07	1.117	576	423
69	10:08	1.133	574	420
70	10:09	1.150	567	413
71	10:10	1.167	562	408
72	10:11	1.183	557	403
73	10:12	1.200	549	395
74	10:13	1.217	545	392
75	10:14	1.233	545	391
76	10:15	1.250	540	387

Raw Data Chart



## Raw Data

Measurement (n	Date & Time	HOBO CO2 Concentration
13	10/21/2016 9:00	617.2
14	10/21/2016 9:01	642.9
15	10/21/2016 9:02	642.2
16	10/21/2016 9:03	642.2
17	10/21/2016 9:04	654.5
18	10/21/2016 9:05	667.3
19	10/21/2016 9:06	678.3
20	10/21/2016 9:07	705.7
21	10/21/2016 9:08	728.9
22	10/21/2016 9:09	742.4
23	10/21/2016 9:10	765.6
24	10/21/2016 9:11	787.5
25	10/21/2016 9:12	815.6
26	10/21/2016 9:13	835.2
27	10/21/2016 9:14	840
28	10/21/2016 9:15	852.3
29	10/21/2016 9:16	865.1
30	10/21/2016 9:17	870
31	10/21/2016 9:18	874.2
32	10/21/2016 9:19	876.7
33	10/21/2016 9:20	876.7
34	10/21/2016 9:21	879.1
35	10/21/2016 9:22	879.1
36	10/21/2016 9:23	881
37	10/21/2016 9:24	884
38	10/21/2016 9:25	881
39	10/21/2016 9:26	877.9
40	10/21/2016 9:27	877.9
41	10/21/2016 9:28	876.7
42	10/21/2016 9:29	873
43	10/21/2016 9:30	869.4
44	10/21/2016 9:31	868.1
45	10/21/2016 9:32	874.2
46	10/21/2016 9:33	876.1
47	10/21/2016 9:34	879.7
48	10/21/2016 9:35	880.3
49	10/21/2016 9:36	882.2
50	10/21/2016 9:37	884
51	10/21/2016 9:38	884
52	10/21/2016 9:39	882.2
53	10/21/2016 9:40	881
54	10/21/2016 9:41	879.1
55	10/21/2016 9:42	879.7
56	10/21/2016 9:43	877.3



57	10/21/2016 9:44	870
58	10/21/2016 9:45	873.6
59	10/21/2016 9:46	870
60	10/21/2016 9:47	865.1
61	10/21/2016 9:48	869.4
62	10/21/2016 9:49	879.1
63	10/21/2016 9:50	887.1
64	10/21/2016 9:51	888.3
65	10/21/2016 9:52	879.1
66	10/21/2016 9:53	837.6
67	10/21/2016 9:54	816.2
68	10/21/2016 9:55	788.8
69	10/21/2016 9:56	768.6
70	10/21/2016 9:57	739.9
71	10/21/2016 9:58	714.3
72	10/21/2016 9:59	695.4
73	10/21/2016 10:00	671.6
74	10/21/2016 10:01	648.4
75	10/21/2016 10:02	632.5
76	10/21/2016 10:03	616.6
77	10/21/2016 10:04	601.3
78	10/21/2016 10:05	597.7
79	10/21/2016 10:06	591
80	10/21/2016 10:07	576.3
81	10/21/2016 10:08	573.9
82	10/21/2016 10:09	566.5
83	10/21/2016 10:10	561.7
84	10/21/2016 10:11	556.8
85	10/21/2016 10:12	548.8
86	10/21/2016 10:13	545.2
87	10/21/2016 10:14	544.6
88	10/21/2016 10:15	540.3
89	10/21/2016 10:16	537.2
90	10/21/2016 10:17	532.4
91	10/21/2016 10:18	564.7
92	10/21/2016 10:19	571.4
93	10/21/2016 10:20	578.8
94	10/21/2016 10:21	580.6
95	10/21/2016 10:22	575.7
96	10/21/2016 10:23	569.6
97	10/21/2016 10:24	550.1
98	10/21/2016 10:25	527.5
99	10/21/2016 10:26	137.4
100	10/21/2016 10:26	
101	10/21/2016 10:26	