



Data Mining for Bee Micro-sensors

Laboratorio Nacional de Análisis y
Síntesis Ecológica

Framework Developed by:

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Quesada

HIGH PERFORMANCE COMPUTING APPLIED TO BIOLOGICAL SCIENCES, UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO - ESCUELA NACIONAL DE ESTUDIOS SUPERIORES UNIDAD JURIQUILLA - LABORATORIO NACIONAL DE ANÁLISIS Y SÍNTESIS ECOLÓGICA

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Part I

Morelia Hive 2



1. Introduction

1.1 Introduction

The main propose of this document is to show a concise report about the activity of bees and behavior in a specific period of time. This report also shows a complete analysis of the most active hours.

This report corresponds to a period of time of 31 day(s). From 2016-07-01 to 2016-08-05. During this period of time, a total amount of 950999 lectures were registered from 61 different bees. There exist a total of 5 non-active days. We define an 'active day' if there is more than one observation. (see Figure 1.1).



2. Analysis of Raw Data

2.0.1 Activity Per Day of Raw Data

This section addresses the analysis of raw data. Which implies that this date is presented without filters or a data preprocessing step to clean the data. This section presents several graphs which reflects the behavior of a beehive during a specific period of time.

Day	Date	# Observations	# Bees per day
1	2016-07-01	5	2
2	2016-07-03	3	1
3	2016-07-04	5	1
4	2016-07-08	20	4
5	2016-07-09	91	5
6	2016-07-10	8	1
7	2016-07-11	11	2
8	2016-07-12	3	2
9	2016-07-13	1	1
10	2016-07-14	689	2
11	2016-07-15	377	4
12	2016-07-16	980	3
13	2016-07-17	135	3
14	2016-07-18	4	1
15	2016-07-19	6	1
16	2016-07-20	7	2
17	2016-07-22	1	1
18	2016-07-23	16023	27
19	2016-07-24	73807	28
20	2016-07-25	83741	12
21	2016-07-26	73707	13

22	2016-07-27	67496	7
23	2016-07-28	15132	3
24	2016-07-29	9108	1
25	2016-07-30	69867	2
26	2016-07-31	75743	4
27	2016-08-01	125216	4
28	2016-08-02	152995	6
29	2016-08-03	54565	6
30	2016-08-04	65197	4
31	2016-08-05	66056	3
--	Average	30677.387096774193	5.032258064516129

2.0.2 Bee Life Cycle

In this section is analyzed the Life Cycle of each bee in the hive

Register	Bee ID	Life Cycle in Days
1	61DC	1
2	0000	1
3	14DC	1
4	0087	1
5	0062	1
6	0071	1
7	0002	1
8	0010	1
9	0014	2
10	0031	2
11	0032	1
12	0036	2
13	0045	3
14	0046	2
15	0053	1
16	0054	2
17	0065	4
18	0066	1
19	0067	1
20	0072	10
21	0074	1
22	0077	5
23	0080	4
24	0083	2
25	0111	7
26	0114	1
27	0116	4
28	0119	6

29	0125	2
30	0126	1
31	0128	1
32	0129	1
33	0136	4
34	0145	1
35	0151	12
36	0160	7
37	0167	2
38	0168	1
39	0170	2
40	0176	14
41	0177	1
42	0178	1
43	0187	2
44	0189	13
45	0192	1
46	0197	2
47	0201	2
48	0203	4
49	0204	5
50	0208	2
51	0213	4
52	0217	3
53	0219	1
54	0222	1
55	0223	1
56	0228	3
57	0231	4
58	0234	2
59	0243	4
60	0244	1
61	0246	1
--	Average	2.8688524590163933

2.0.3 Analysis of Activity per Hour

Hive 2observationsPerdayUnclean.png Hive 2observationsPerdayUnclean.png

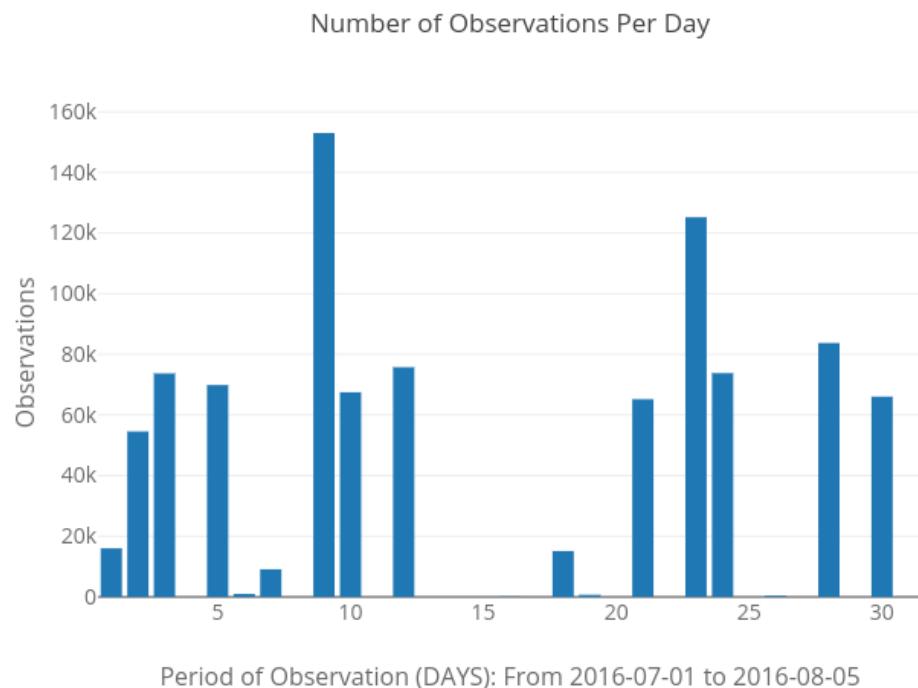


Figure 2.1: Number of Observations per Day

Hive 2differentBeesPerdayUnclean.png Hive 2differentBeesPerdayUnclean.png

Register of Different Bees per Day

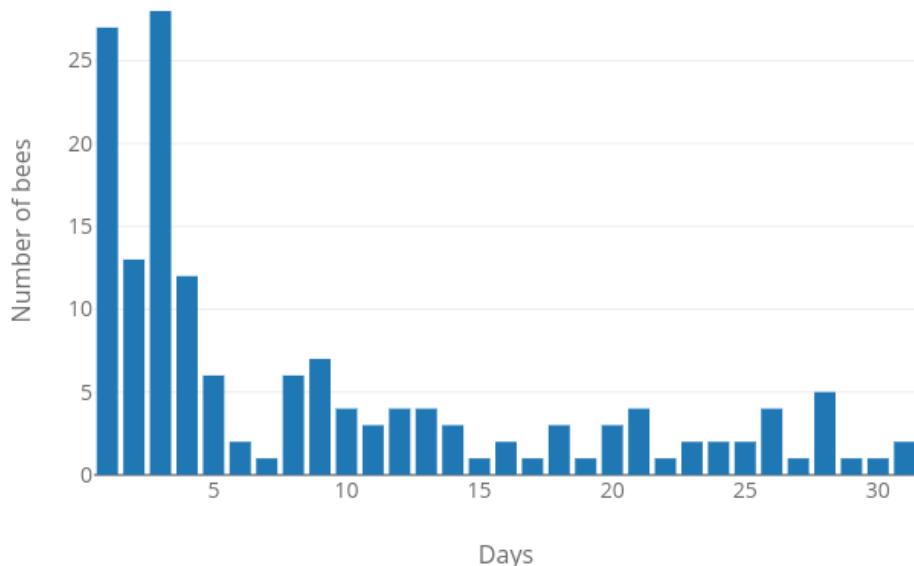


Figure 2.2: Different Bees Per Day

Hive 2pieBeeLifeCycleUnclean.png Hive 2pieBeeLifeCycleUnclean.png

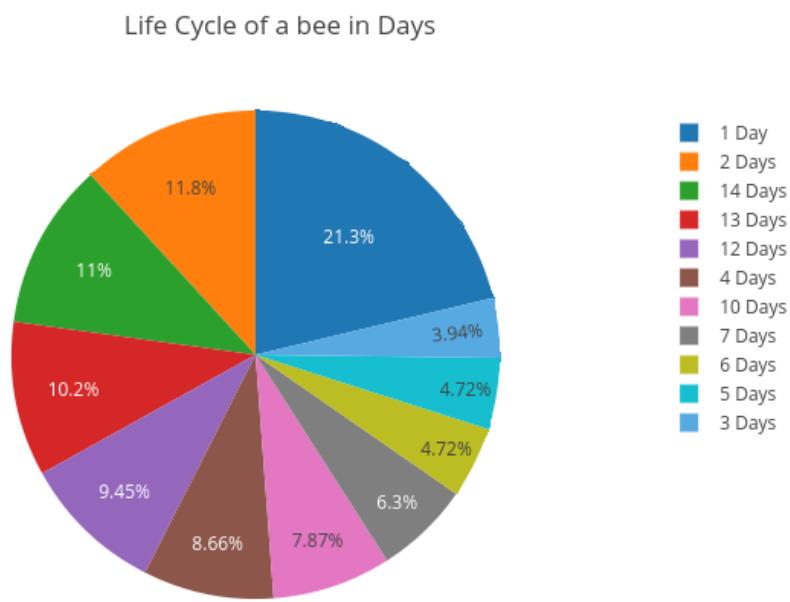


Figure 2.3: Bee Life cycle in days

Hive 2histogramUnclean.png Hive 2histogramUnclean.png

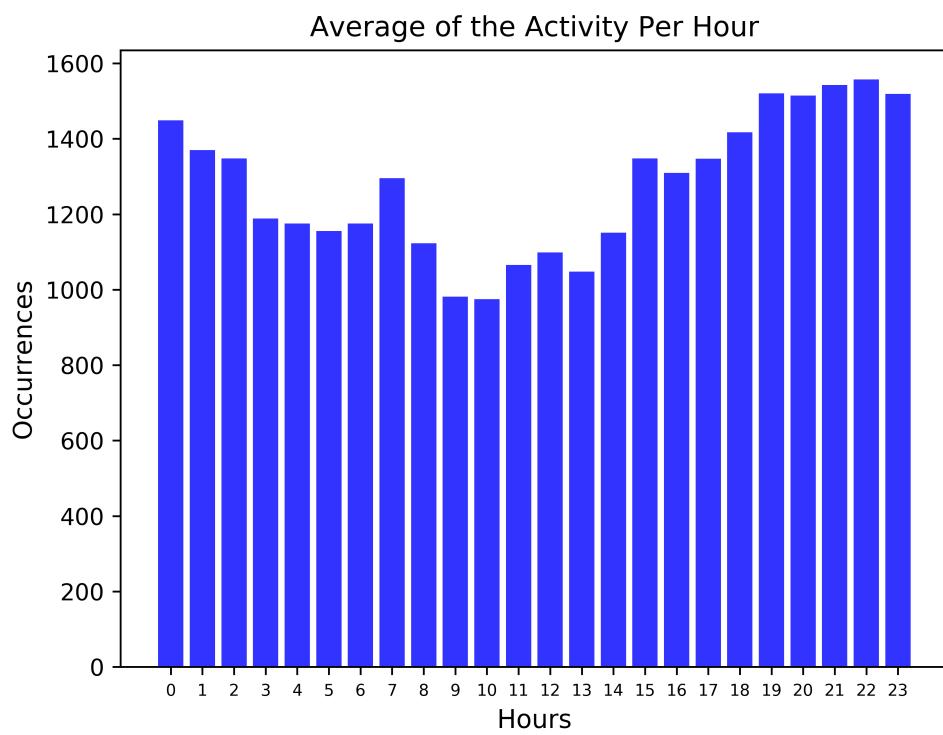


Figure 2.4: Histogram of frequencies per hour

Hive 2histogramUnclean.png Hive 2histogramUnclean.png

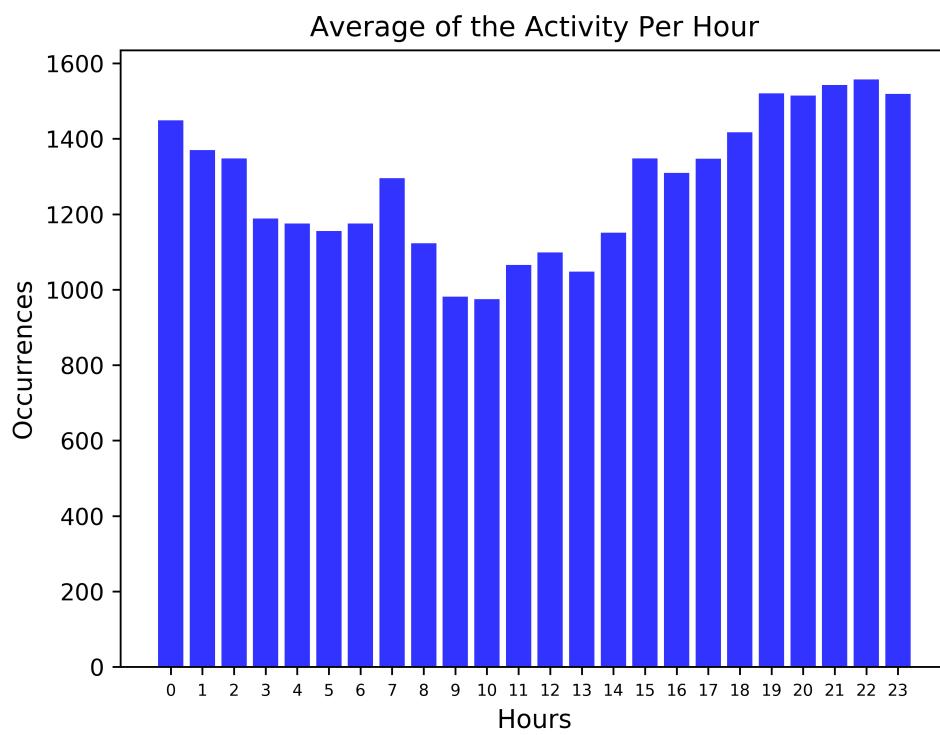


Figure 2.5: Histogram of frequencies per hour. It includes standard deviation



3. Analysis of Clean Data

3.0.1 Activity Per Day of Clean Data

In this section is presented an analysis of input data. During this analysis some filters were applied. One of these filters is the definition of a threshold which removes all the observations that fall in a period of time less than 60 seconds. This preprocessing step tends to remove all the lost chips which generated unnecessary and repeated registers

Day	Date	# Observations	# Bees per day
1	2016-07-08	5	3
2	2016-07-09	15	3
3	2016-07-10	1	1
4	2016-07-11	7	2
5	2016-07-12	1	1
6	2016-07-14	38	2
7	2016-07-15	64	4
8	2016-07-16	97	2
9	2016-07-17	26	3
10	2016-07-18	3	1
11	2016-07-19	2	1
12	2016-07-20	2	2
13	2016-07-23	131	19
14	2016-07-24	311	19
15	2016-07-25	482	9
16	2016-07-26	414	7
17	2016-07-27	450	5
18	2016-07-28	19	2
19	2016-07-29	79	1
20	2016-07-30	80	2

21	2016-07-31	11	3
22	2016-08-01	104	2
23	2016-08-02	60	3
24	2016-08-03	209	2
25	2016-08-04	246	3
26	2016-08-05	185	2
--	Average	117.0	4.0

3.0.2 Bee Life Cycle

Register	Bee ID	Life Cycle in Days
1	0062	1
2	0071	1
3	0014	1
4	0031	2
5	0045	2
6	0046	1
7	0053	1
8	0054	2
9	0065	1
10	0066	1
11	0072	10
12	0077	4
13	0080	2
14	0111	1
15	0114	1
16	0116	3
17	0119	6
18	0125	2
19	0126	1
20	0128	1
21	0129	1
22	0136	4
23	0145	1
24	0151	8
25	0160	6
26	0167	1
27	0170	2
28	0176	14
29	0178	1
30	0187	1
31	0189	13
32	0201	2
33	0203	4

34	0204	5
35	0208	2
36	0213	4
37	0217	2
38	0222	1
39	0223	1
40	0228	1
41	0231	3
42	0234	2
43	0243	1
44	0244	1
45	0246	1
--	Average	2.8

3.0.3 Analysis of Activity per Hour

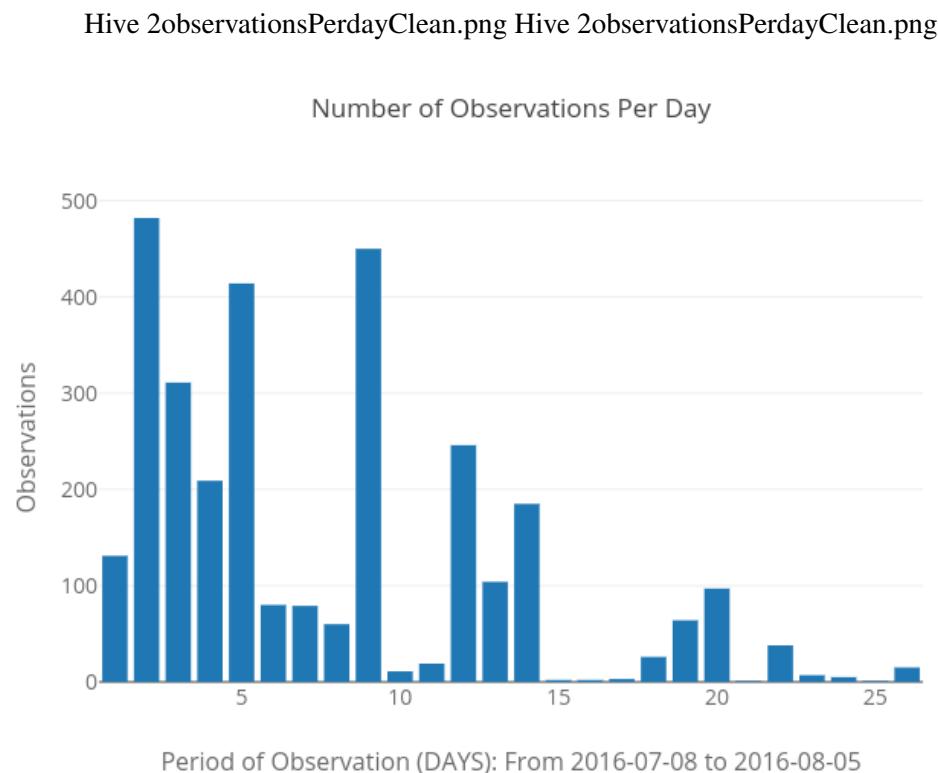


Figure 3.1: Number of Observations per Day

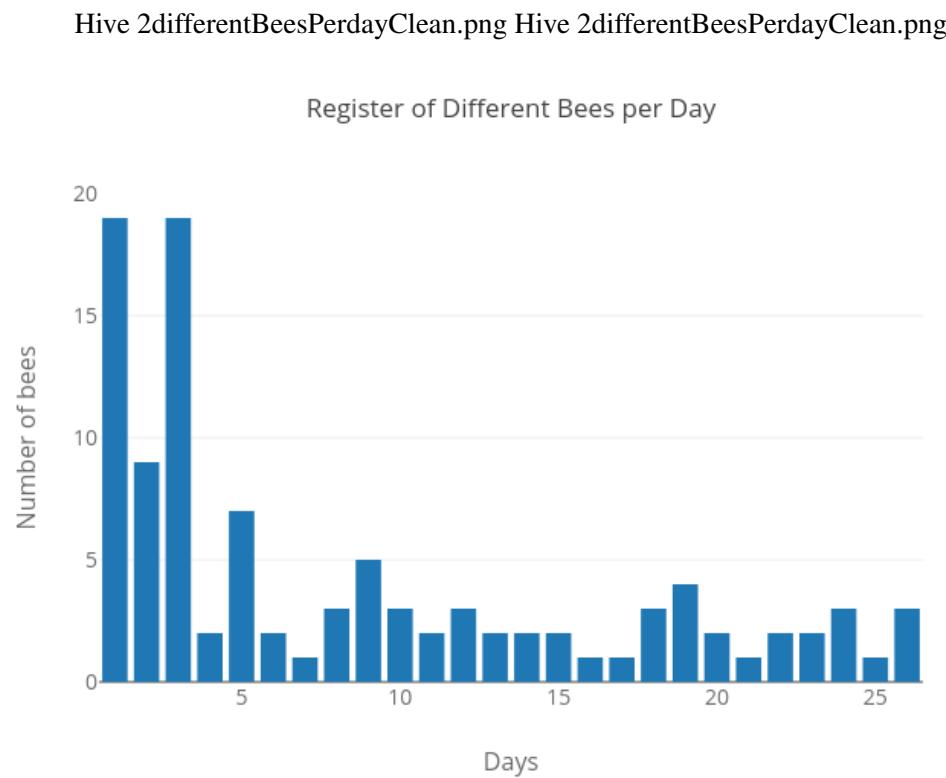


Figure 3.2: Different Bees Per Day

Hive 2pieBeeLifeCycleClean.png Hive 2pieBeeLifeCycleClean.png

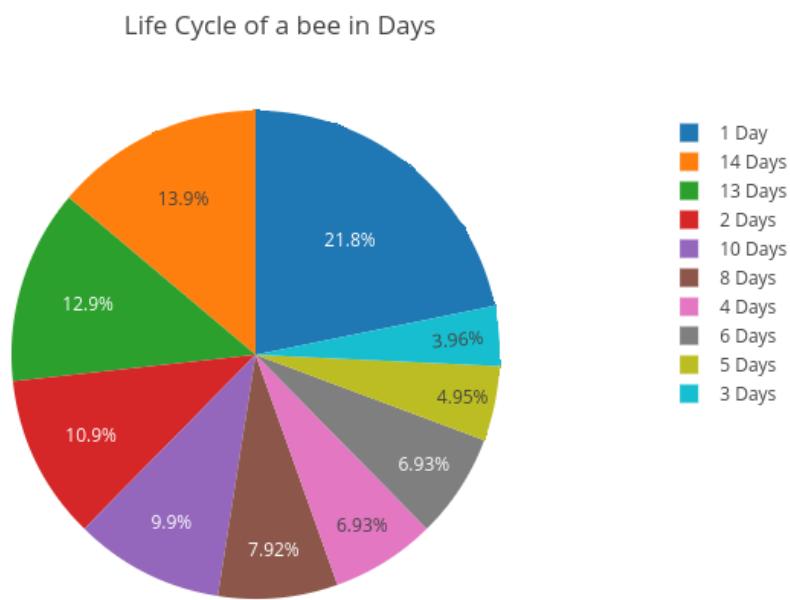


Figure 3.3: Bee Life cycle in days

Hive 2histogramClean.png Hive 2histogramClean.png

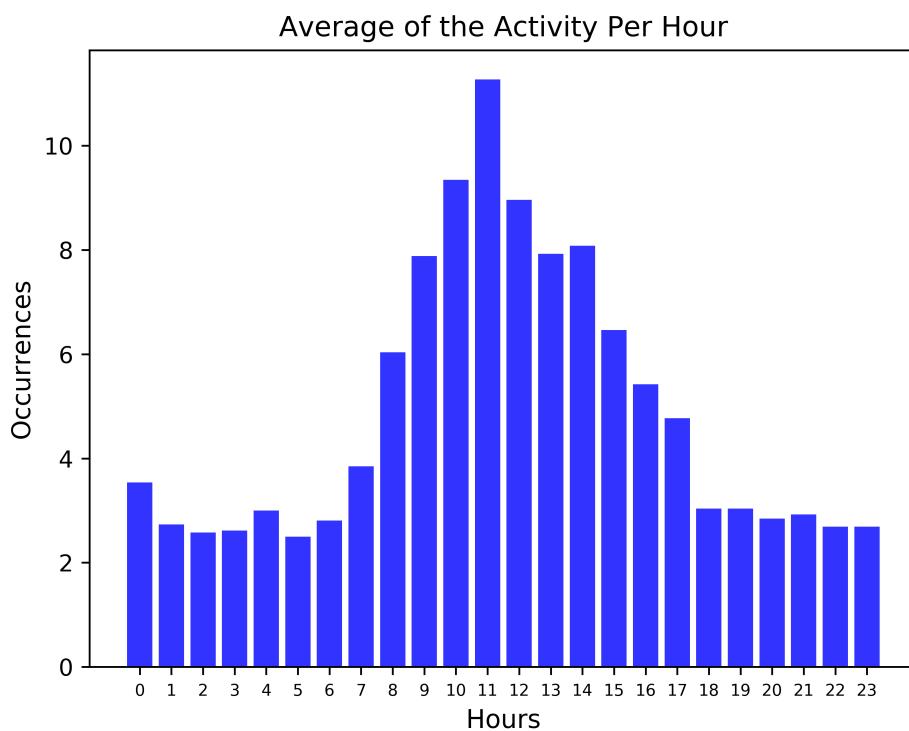


Figure 3.4: Histogram of frequencies per hour

Hive 2histogramClean.png Hive 2histogramClean.png

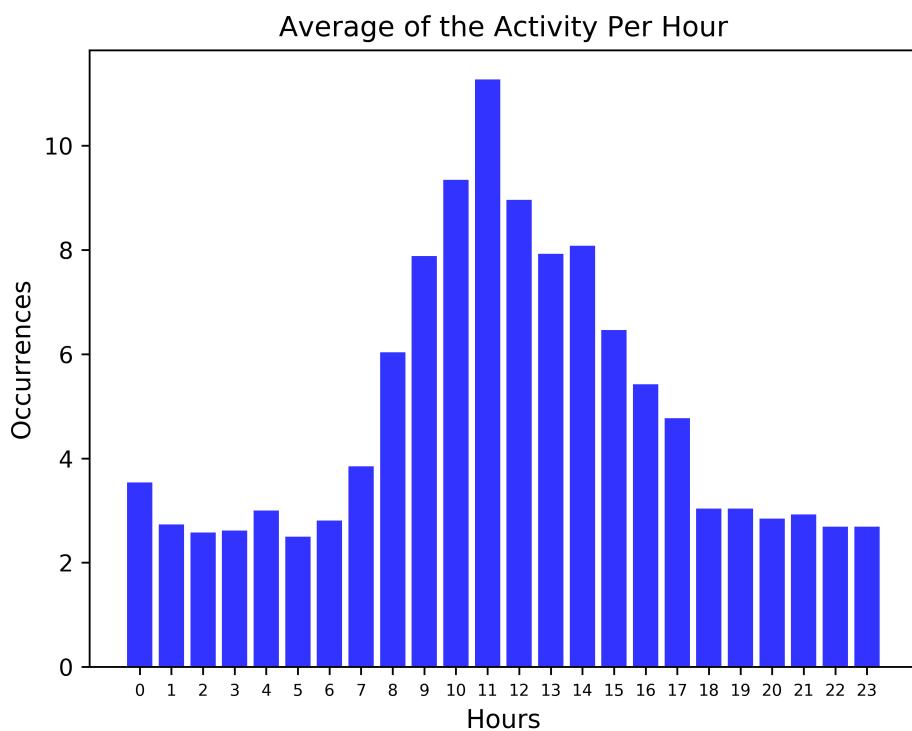


Figure 3.5: Histogram of frequencies per hour. It includes standard deviation

Part II

Morelia Hive 1



4. Introduction

4.1 Introduction

The main propose of this document is to show a concise report about the activity of bees and behavior in a specific period of time. This report also shows a complete analysis of the most active hours.

This report corresponds to a period of time of 31 day(s). From 2016-07-02 to 2016-08-05. During this period of time, a total amount of 3056 lectures were registered from 51 different bees. There exist a total of 5 non-active days. We define an 'active day' if there is more than one observation. (see Figure 1.1).



5. Analysis of Raw Data

5.0.1 Activity Per Day of Raw Data

This section addresses the analysis of raw data. Which implies that this date is presented without filters or a data preprocessing step to clean the data. This section presents several graphs which reflects the behavior of a beehive during a specific period of time.

Day	Date	# Observations	# Bees per day
1	2016-07-02	1	1
2	2016-07-03	1	1
3	2016-07-08	50	8
4	2016-07-09	145	11
5	2016-07-10	115	10
6	2016-07-11	50	7
7	2016-07-12	21	5
8	2016-07-13	26	7
9	2016-07-14	65	4
10	2016-07-15	731	14
11	2016-07-16	510	11
12	2016-07-17	68	5
13	2016-07-18	43	3
14	2016-07-19	32	3
15	2016-07-20	33	3
16	2016-07-21	16	3
17	2016-07-22	6	2
18	2016-07-23	342	16
19	2016-07-24	256	12
20	2016-07-25	66	8
21	2016-07-26	105	7

22	2016-07-27	29	5
23	2016-07-28	21	5
24	2016-07-29	37	6
25	2016-07-30	27	4
26	2016-07-31	26	4
27	2016-08-01	41	5
28	2016-08-02	39	5
29	2016-08-03	35	5
30	2016-08-04	21	5
31	2016-08-05	98	5
--	Average	98.58064516129032	6.129032258064516

5.0.2 Bee Life Cycle

In this section is analyzed the Life Cycle of each bee in the hive

Register	Bee ID	Life Cycle in Days
1	0004	1
2	0005	1
3	0023	1
4	0024	5
5	0029	8
6	0031	1
7	0053	5
8	0055	1
9	0056	1
10	0060	1
11	0061	1
12	0062	1
13	0063	6
14	0064	1
15	0068	16
16	0071	1
17	0075	5
18	0077	18
19	0079	2
20	0081	1
21	0082	1
22	0090	3
23	0093	1
24	0095	1
25	0108	14
26	0112	1
27	0130	14
28	0137	5

29	0145	3
30	0146	2
31	0153	3
32	0154	1
33	0155	1
34	0156	2
35	0157	2
36	0162	3
37	0165	2
38	0188	7
39	0189	2
40	0194	1
41	0203	1
42	0208	2
43	0212	14
44	0213	14
45	0215	1
46	0220	1
47	0223	2
48	0234	14
49	0235	2
50	0250	1
51	0137	1
--	Average	3.9019607843137254

5.0.3 Analysis of Activity per Hour

Hive 1observationsPerdayUnclean.png Hive 1observationsPerdayUnclean.png

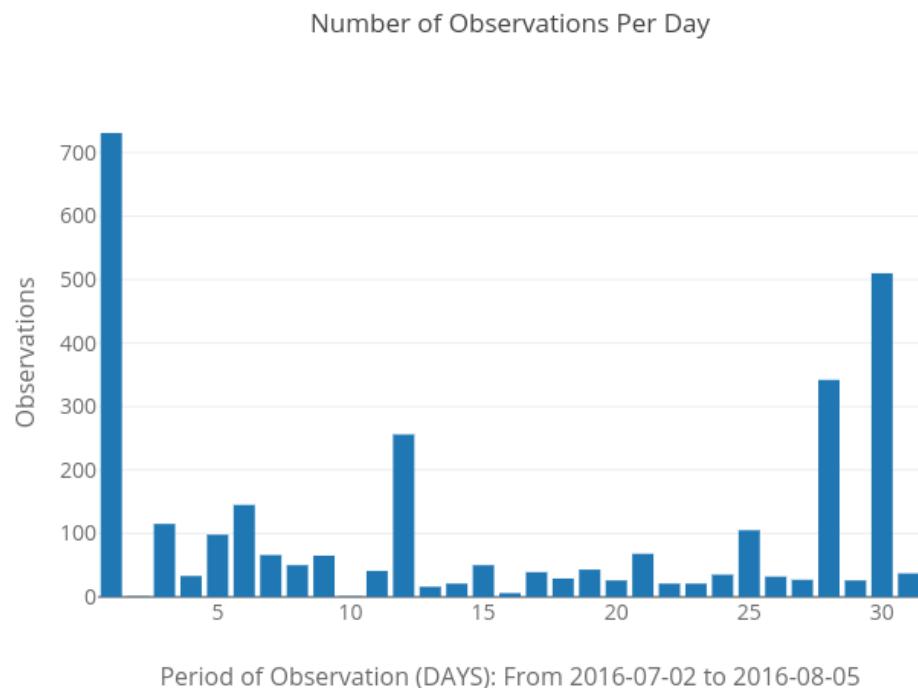


Figure 5.1: Number of Observations per Day

Hive 1differentBeesPerdayUnclean.png Hive 1differentBeesPerdayUnclean.png

Register of Different Bees per Day

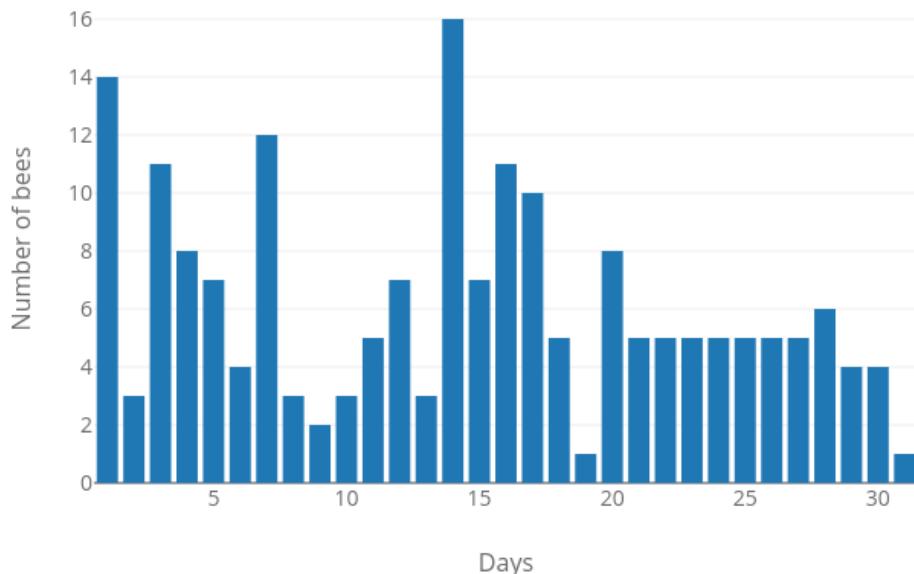


Figure 5.2: Different Bees Per Day

Hive 1pieBeeLifeCycleUnclean.png Hive 1pieBeeLifeCycleUnclean.png

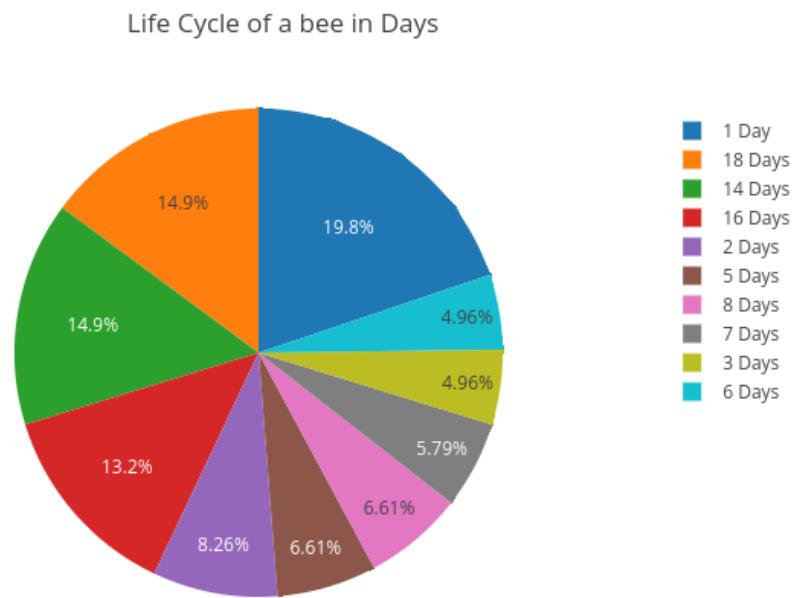


Figure 5.3: Bee Life cycle in days

Hive 1histogramUnclean.png Hive 1histogramUnclean.png

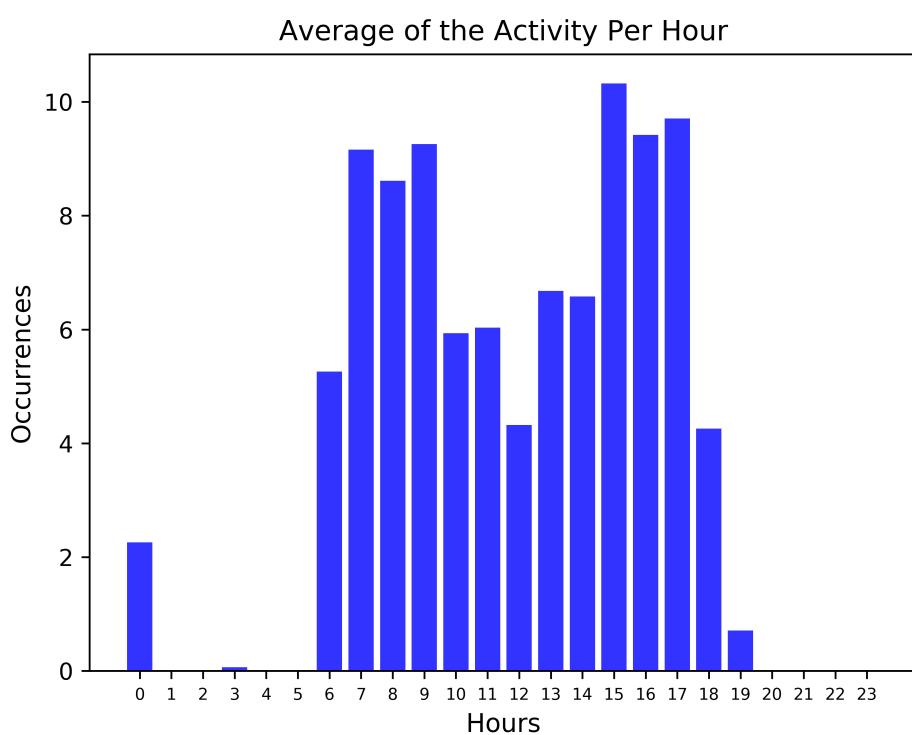


Figure 5.4: Histogram of frequencies per hour

Hive 1histogramUnclean.png Hive 1histogramUnclean.png

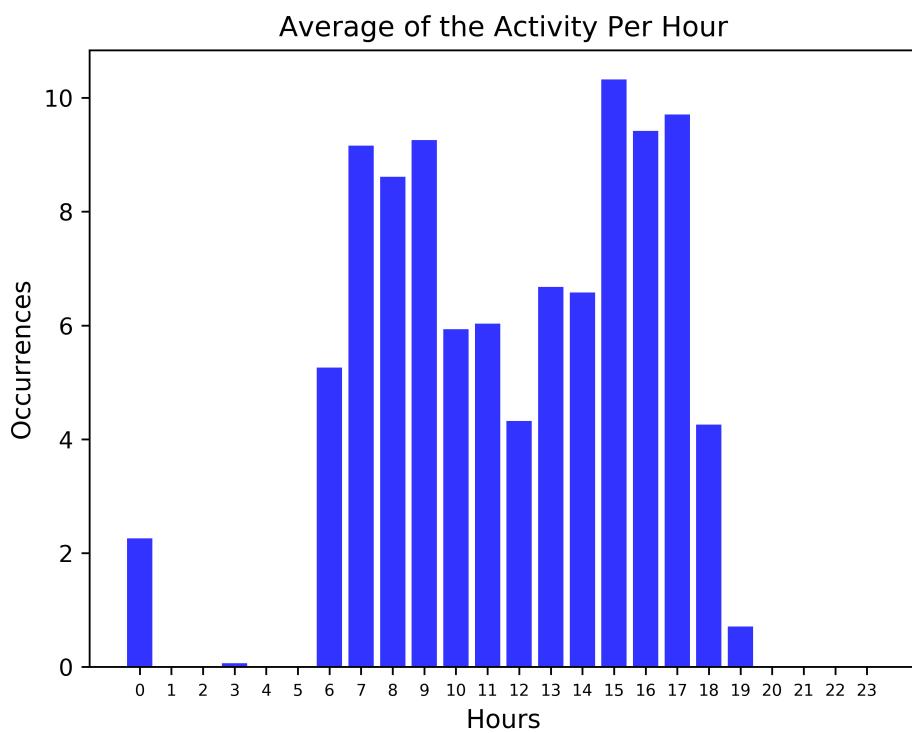


Figure 5.5: Histogram of frequencies per hour. It includes standard deviation



6. Analysis of Clean Data

6.0.1 Activity Per Day of Clean Data

In this section is presented an analysis of input data. During this analysis some filters were applied. One of these filters is the definition of a threshold which removes all the observations that fall in a period of time less than 60 seconds. This preprocessing step tends to remove all the lost chips which generated unnecessary and repeated registers

Day	Date	# Observations	# Bees per day
1	2016-07-08	9	3
2	2016-07-09	35	10
3	2016-07-10	42	8
4	2016-07-11	33	5
5	2016-07-12	12	4
6	2016-07-13	16	5
7	2016-07-14	16	3
8	2016-07-15	143	8
9	2016-07-16	69	7
10	2016-07-17	31	5
11	2016-07-18	20	3
12	2016-07-19	22	3
13	2016-07-20	26	3
14	2016-07-21	12	2
15	2016-07-22	4	2
16	2016-07-23	86	10
17	2016-07-24	60	11
18	2016-07-25	24	4
19	2016-07-26	36	7
20	2016-07-27	19	4

21	2016-07-28	13	3
22	2016-07-29	25	4
23	2016-07-30	19	4
24	2016-07-31	20	4
25	2016-08-01	28	5
26	2016-08-02	25	5
27	2016-08-03	22	5
28	2016-08-04	15	4
29	2016-08-05	23	5
--	Average	31.20689655172414	5.0344827586206895

6.0.2 Bee Life Cycle

Register	Bee ID	Life Cycle in Days
1	0024	4
2	0029	5
3	0053	3
4	0055	1
5	0062	1
6	0063	6
7	0068	16
8	0071	1
9	0075	5
10	0077	18
11	0079	2
12	0090	2
13	0095	1
14	0108	14
15	0112	1
16	0130	13
17	0137	4
18	0145	2
19	0146	1
20	0153	3
21	0155	1
22	0156	1
23	0157	2
24	0162	2
25	0165	2
26	0188	5
27	0189	2
28	0203	1
29	0208	2
30	0212	13

31	0213	11
32	0215	1
33	0223	1
34	0234	14
35	0235	2
--	Average	4.6571428571428575

6.0.3 Analysis of Activity per Hour

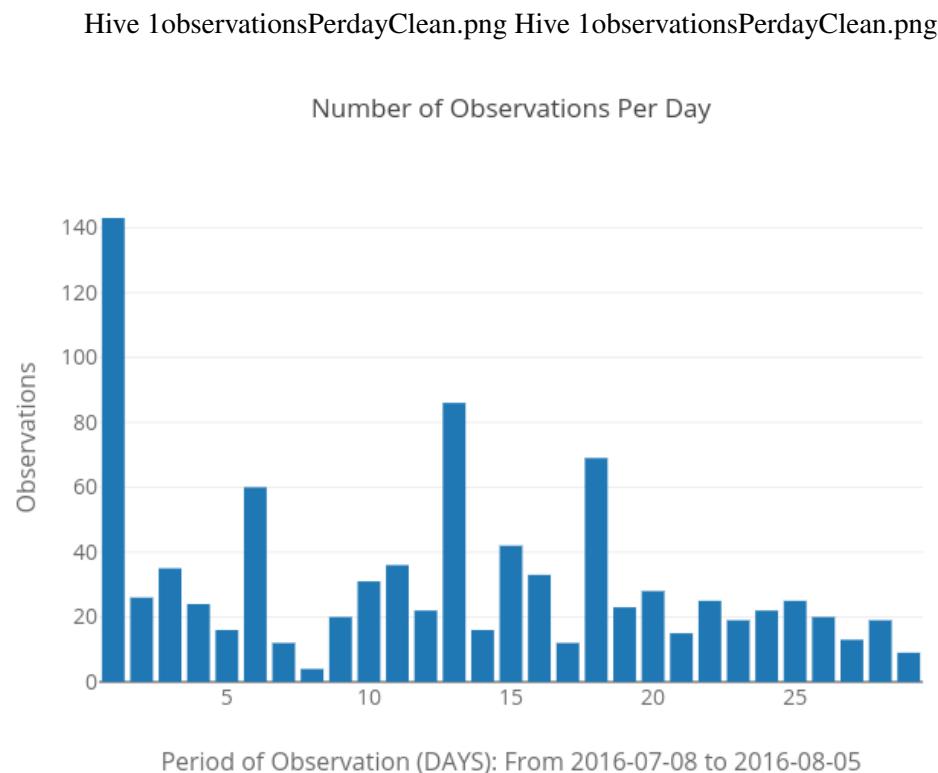


Figure 6.1: Number of Observations per Day

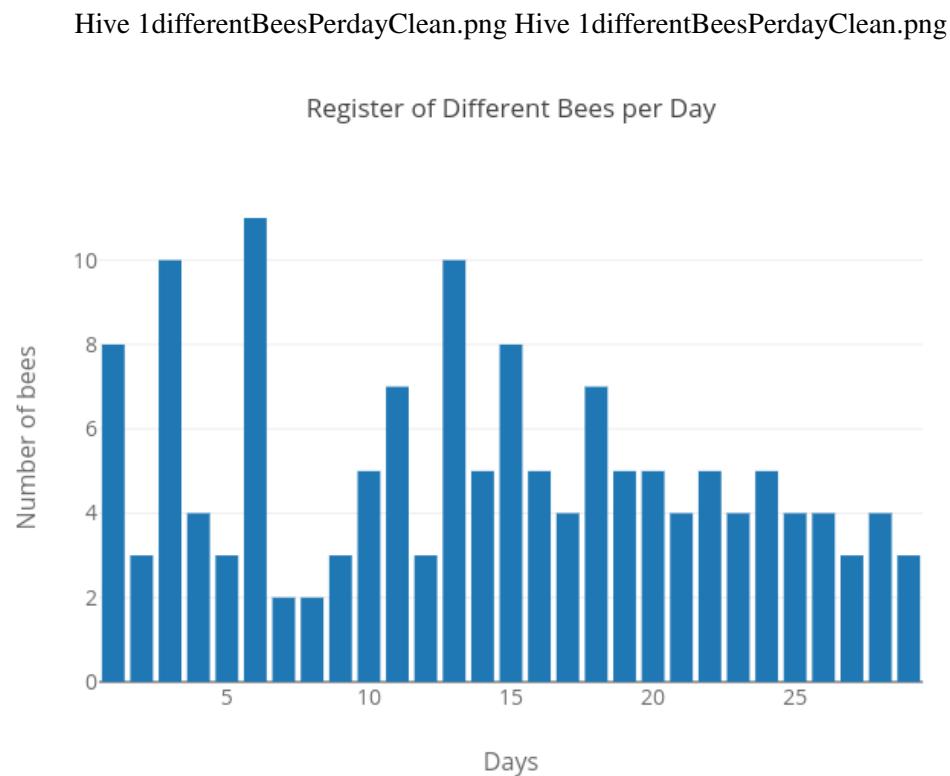


Figure 6.2: Different Bees Per Day

Hive 1pieBeeLifeCycleClean.png Hive 1pieBeeLifeCycleClean.png

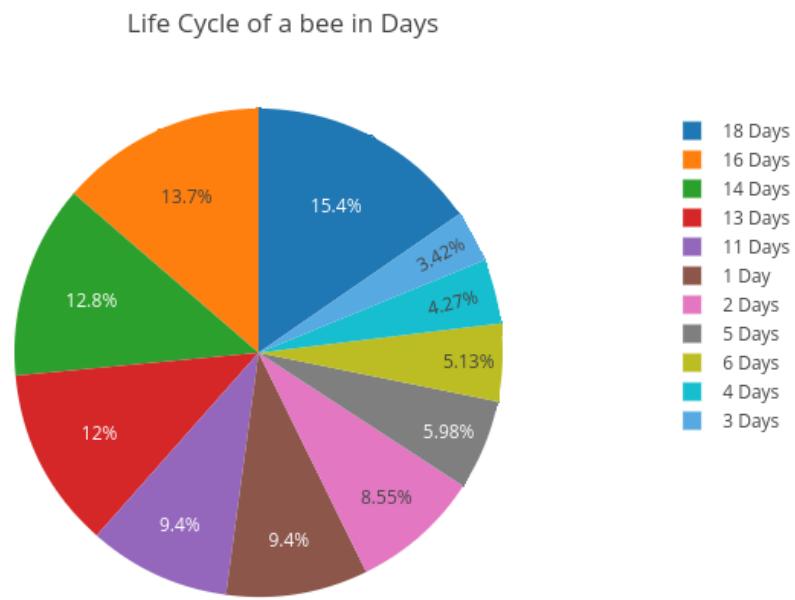


Figure 6.3: Bee Life cycle in days

Hive 1histogramClean.png Hive 1histogramClean.png

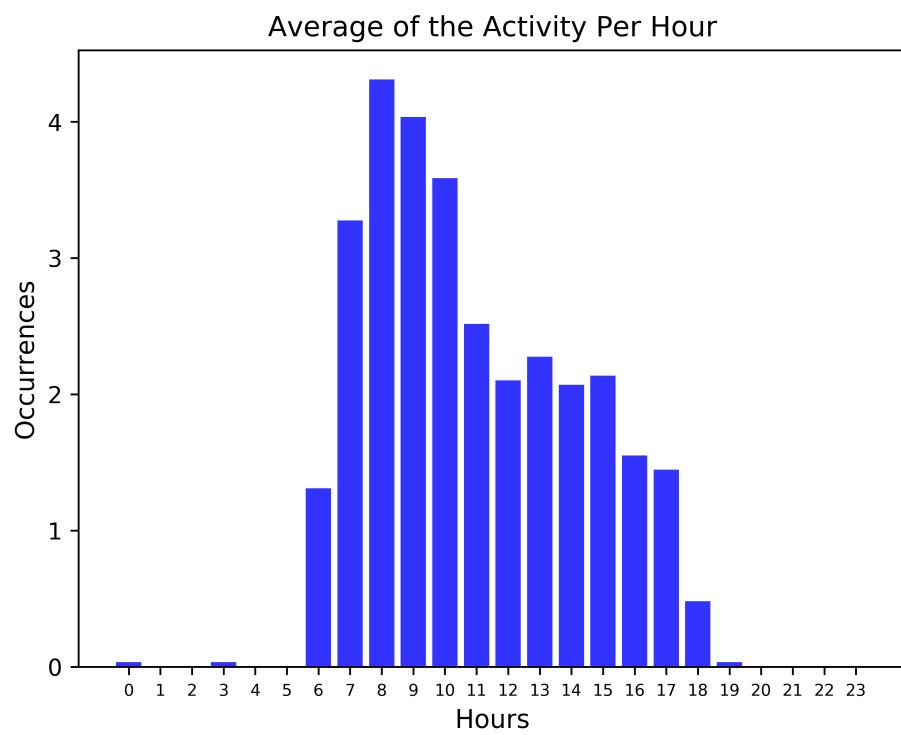


Figure 6.4: Histogram of frequencies per hour

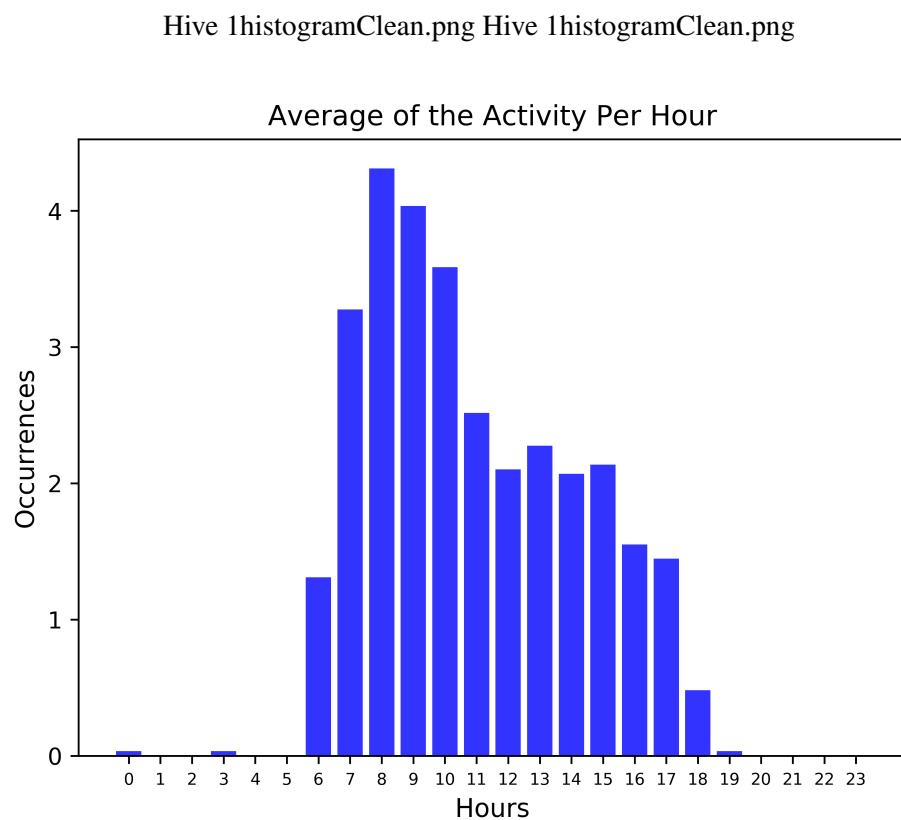


Figure 6.5: Histogram of frequencies per hour. It includes standard deviation