

## Observations

The purpose of this experiment is to observe whether or not stress from academic exams affects pulse rate and blood oxygen level (SpO<sub>2</sub>) of students in school. In this experiment four classes are being tested: math, history, science and Spanish. Three sets of resting pulse rates and SpO<sub>2</sub> (control) were collected during regular class hours. Data was also collected before and after an exam was taken in each class.

A device known as a pulse oximeter was used in experimentation to collect pulse rates and blood oxygen level of each student. The pulse oximeter is a small device that can be easily fit into the finger of the user. After a few seconds a pulse rate and SpO<sub>2</sub> reading will show up on the screen. This is what the students recorded during experimentation. The data for pulse rate is measured in beats per minute (bpm) and the data for blood oxygen is measured by the percentage of oxygen in the blood.

Some minor problems were encountered during the actual experimentation. The 2net hub is a device that can transfer data from medical devices to the user's e-mail. The intent in this project was to use the 2net hub to automate the data collection process. Since electrical outlets were not available in some classes, the 2net hub could not be used consistently. Another problem that appeared during experimentation was that some students were not present at school on the days some classes were tested. Therefore, some students only have one or two control readings. This was the same case for tests. As a result, some graphs have more students than others.

During experimentation it was observed that some unrecognized variables might have been affecting the data. After more research, it was proved that factors like a student's weight and size will have effects on that student's pulse rate. A big person will have a higher pulse rate than a thin or more athletic person. Since variables like these were only recognized in the middle of testing, they were not considered during experimentation. However, this is not a significant factor because only changes in pulse rate and SpO<sub>2</sub> are being considered.

The key data is comprised of every control data set, every reading before an exam and every reading after an exam. Averages were calculated for each set. The average of every single control data is close to 80 beats per minute (bpm). The average of every reading before an exam is close to 91 bpm. Lastly, the average of the readings collected after each exam is around 82 bpm. The hypothesis created before experimentation was that the change between pulse rate before and after exams would be 20 bpm. Based on the data presented, the change between the average pulse before exams and average pulse after exams is only 9 bpm. Additionally, the change between the average pulse before exams and the average control pulse rate is 11 bpm. This proves that the hypothesis is partially correct. Although, the change is only 9 bpm compared

to the 20 bpm predicted in the hypothesis, there still is an observable increase in pulse rate. This increase in pulse rate before exams may be attributed to stress from the exams.

The same procedure was repeated for analyzing the blood oxygen data. It was initially hypothesized that the SpO<sub>2</sub> would experience no noticeable change between before and after exams. The average of every single control data collected for SpO<sub>2</sub> was close to 98%. The average of every SpO<sub>2</sub> reading before exams was 97.5%. Lastly, the average of the SpO<sub>2</sub> readings collected after exams was around 98%. This proves that the hypothesis was correct because the difference between SpO<sub>2</sub> before and after exams is hardly recognizable.

In addition, simple calculus was used to calculate standard deviation (S.Dev). Standard deviation will help show how much the data points vary by. SpO<sub>2</sub> does not vary as much as pulse rate, therefore reducing the standard deviation. The standard deviation of the change in pulse rate before and after exams is 15.57 while the standard deviation for the SpO<sub>2</sub> change is only 2.96. This shows that the amount of variance in the SpO<sub>2</sub> readings before the exam is less than the pulse rate readings. However, standard deviation can also be used to tell whether or not a lot of students got stressed. The average change in pulse rate is 10.02 beats per minute, but the standard deviation is 15.57. This shows that the data was widely spread out among all the students and that pulse rates went up, down or stayed neutral. Therefore, it can be concluded that some students experienced changes in pulse and some didn't.

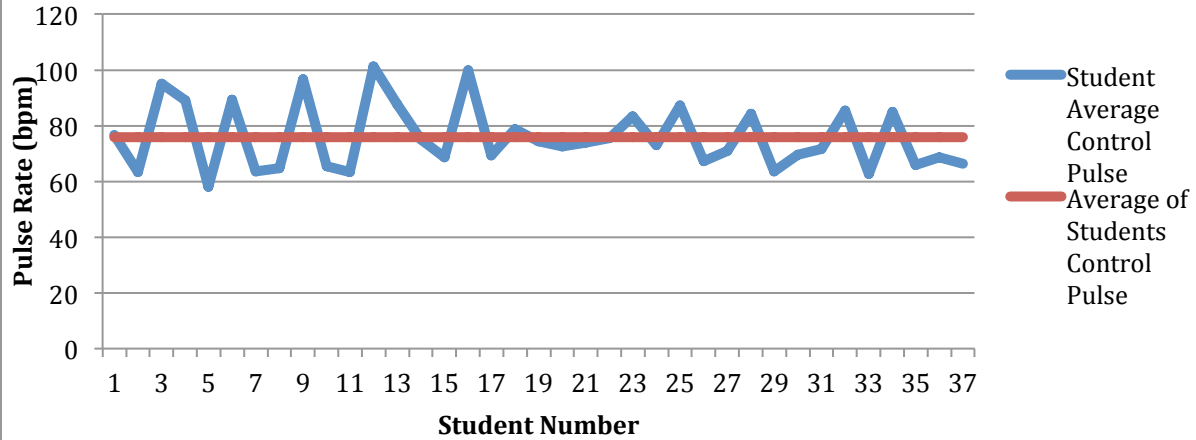
Overall, the project was executed smoothly. The experimentation went as planned and a substantial amount of data (a total of 852 samples) was collected. The data for each class showed that there was an observable change in pulse rate before and after exams. Likewise, when looking at every data point and comparing the pulse rates taken before and after exams, an increase in pulse rate was observed before exams. The hypothesis was not accurately matched, but a significant change was discovered.

## Math Data Tables/ Graphs

Pulse Rates In Math Class (Exam 1)

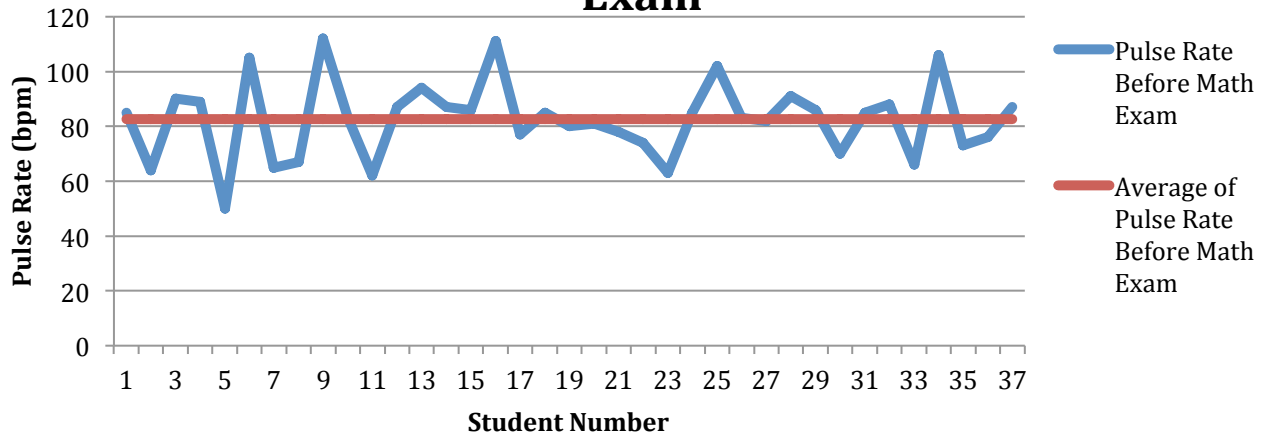
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	76.67	85	75	10	1.67
2	63.33	64	71	-7	-7.67
3	95	90	83	7	12.00
4	89	89	84	5	5.00
5	58	50	60	-10	-2.00
6	89.33	105	101	4	-11.67
7	63.67	65	66	-1	-2.33
8	64.67	67	70	-3	-5.33
9	96.67	112	90	22	6.67
10	65.33	83	75	8	-9.67
11	63.33	62	88	-26	-24.67
12	101.33	87	73	14	28.33
13	87.67	94	90	4	-2.33
14	75	87	90	-3	-15.00
15	68.67	86	62	24	6.67
16	100	111	96	15	4.00
17	69.33	77	66	11	3.33
18	78.67	85	79	6	-0.33
19	74.33	80	75	5	-0.67
20	72.67	81	71	10	1.67
21	74	78	68	10	6.00
22	75.50	74	67	7	8.50
23	83.33	63	60	3	23.33
24	73	85	88	-3	-15.00
25	87.33	102	90	12	-2.67
26	67.33	83	74	9	-6.67
27	71	82	74	8	-3.00
28	84.33	91	97	-6	-12.67
29	63.67	86	58	28	5.67
30	69.67	70	70	0	-0.33
31	71.67	85	77	8	-5.33
32	85.33	88	77	11	8.33
33	62.67	66	54	12	8.67
34	85	106	83	23	2.00
35	66	73	63	10	3.00
36	68.67	76	61	15	7.67
37	66.33	87	75	12	-8.67
<b>Average</b>	<b>75.88</b>	<b>82.57</b>	<b>75.70</b>	<b>6.86</b>	<b>0.18</b>
<b>S.Dev</b>	<b>11.41035359</b>	<b>13.75763285</b>	<b>11.74702922</b>	<b>10.04896704</b>	<b>10.01170081</b>

## Students Average Control Pulse Rate and the Average of Students Control Pulse (Math)



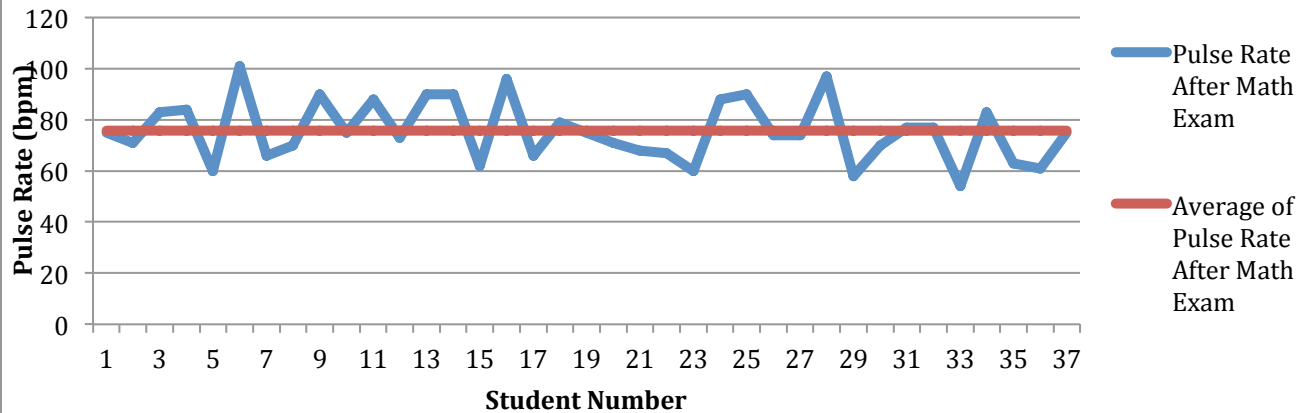
This graph is a comparison of student's average control pulse rate and the average of every students average control pulse. The student's average control pulse rate was attained through finding the average of the three data points collected in the math class for the control group (resting pulse rate).

## Students Pulse Rate Before Math Exam and the Average of the Pulse Rate Before Math Exam



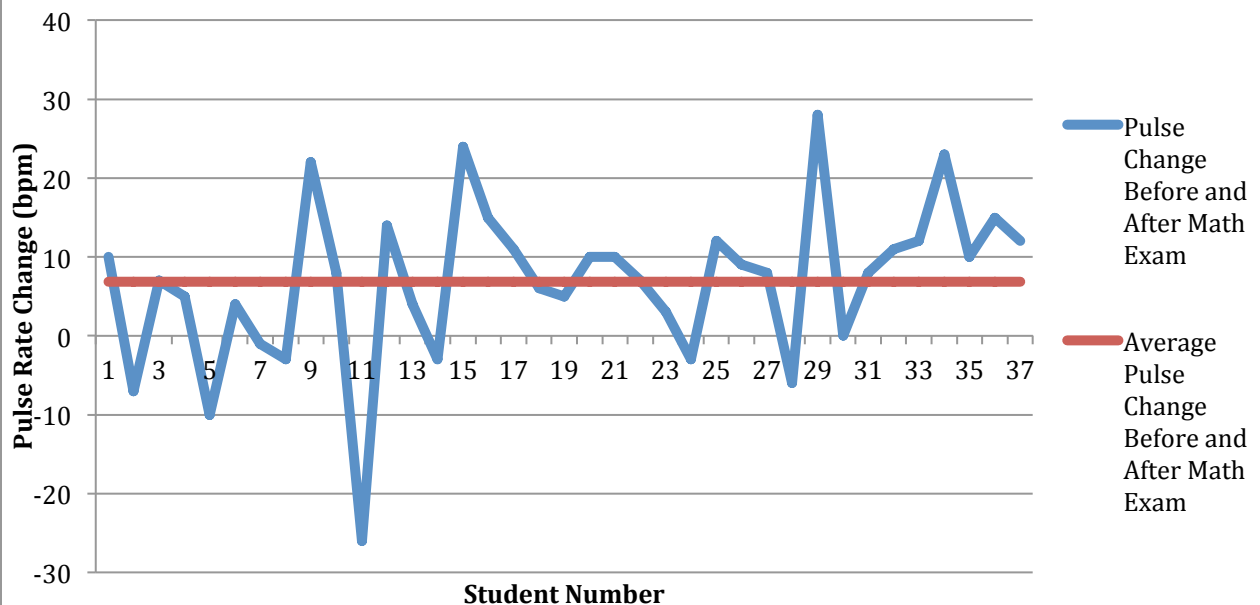
This graph is a comparison between each student's pulse rate before a math exam and the average of all the readings taken before the math exam. This will show how each student's pulse rate before the exam varies from the average line.

## Students Pulse Rate After Math Exam and Average of the Pulse Rate After Math Exam



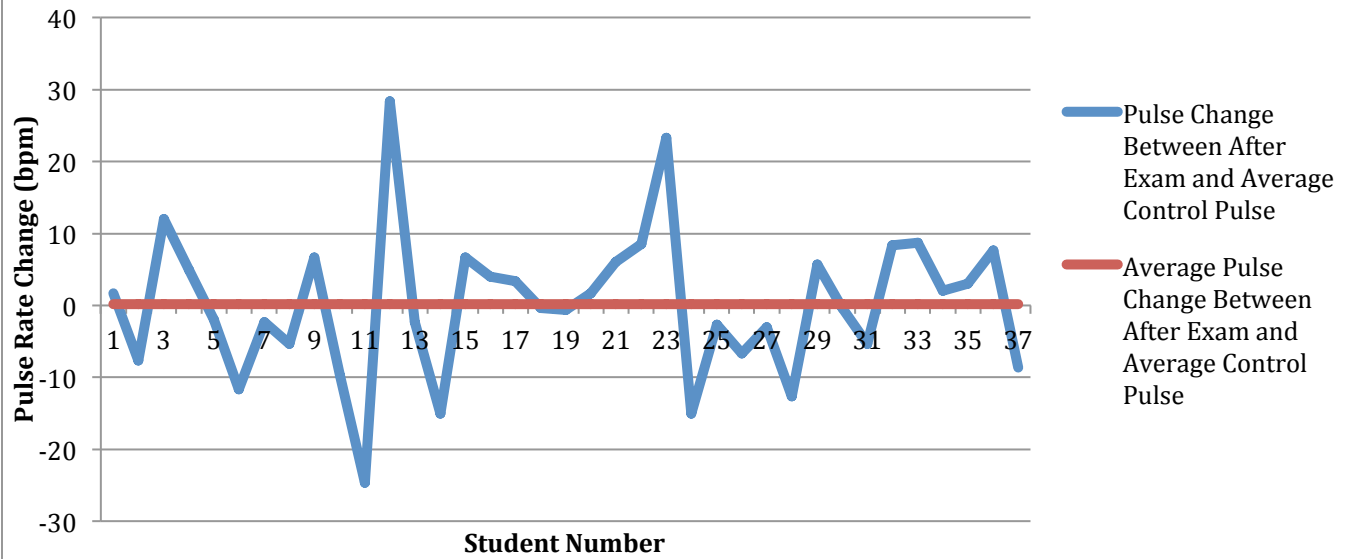
This graph is a comparison of each student's pulse rate after the exam and the average of all the readings taken after the math exam. Each student's pulse rate is being compared to the average among all students.

## Change in Pulse Before and After Math Exam



This graph is a comparison between each student's change in pulse before and after a math exam. It is being compared with the average change before and after the exam among all students in the class.

## Pulse Change Between After Math Exam and Average Control Pulse

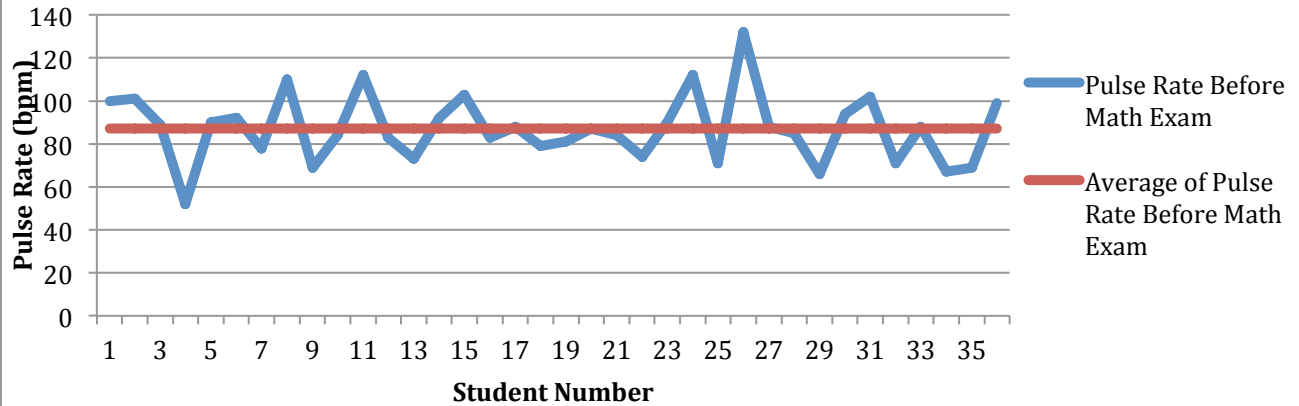


This graph is a comparison between each student's change in pulse rate after a math exam and their average control pulse rate. It is being compared to the average of every student's change. This graph will prove whether or not a student's pulse rate returned to normal after the exam was finished.

Pulse Rates In Math Class (Exam 2)

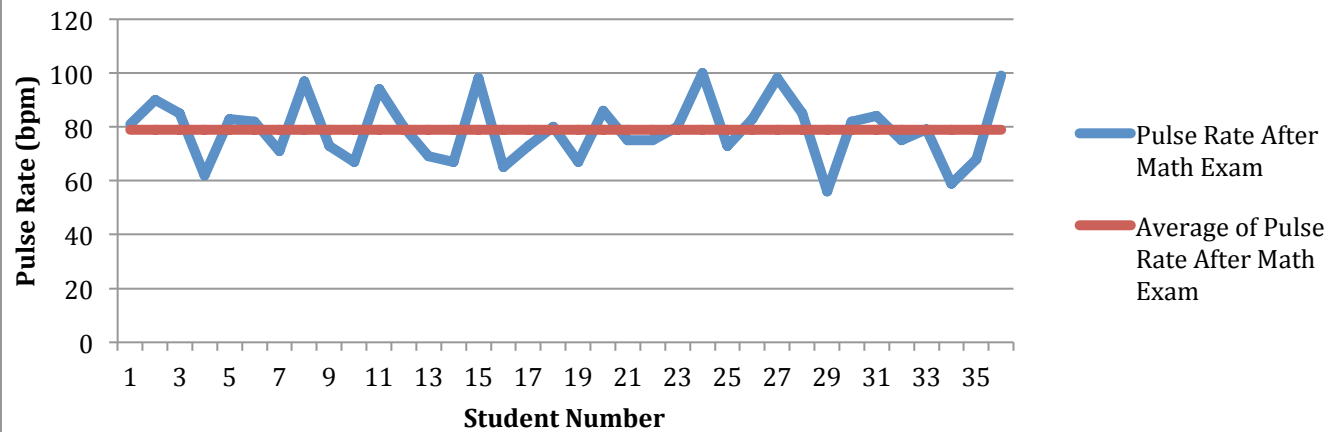
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	63.33	100	81	19	-17.67
2	95	101	90	11	5.00
3	89	89	85	4	4.00
4	58	52	62	-10	-4.00
5	89.33	90	83	7	6.33
6	63.67	92	82	10	-18.33
7	64.67	78	71	7	-6.33
8	96.67	110	97	13	-0.33
9	65.33	69	73	-4	-7.67
10	63.33	84	67	17	-3.67
11	101.33	112	94	18	7.33
12	87.67	83	80	3	7.67
13	75	73	69	4	6.00
14	68.67	92	67	25	1.67
15	100	103	98	5	2.00
16	69.33	83	65	18	4.33
17	78.67	88	73	15	5.67
18	74.33	79	80	-1	-5.67
19	72.67	81	67	14	5.67
20	74	87	86	1	-12.00
21	75.5	84	75	9	0.50
22	83.33	74	75	-1	8.33
23	73	90	80	10	-7.00
24	87.33	112	100	12	-12.67
25	67.33	71	73	-2	-5.67
26	71	132	83	49	-12.00
27	84.33	88	98	-10	-13.67
28	63.67	85	85	0	-21.33
29	69.67	66	56	10	13.67
30	71.67	94	82	12	-10.33
31	85.33	102	84	18	1.33
32	62.67	71	75	-4	-12.33
33	85	88	79	9	6.00
34	66	67	59	8	7.00
35	68.67	69	68	1	0.67
36	66.33	99	99	0	-32.67
<b>Average</b>	<b>75.86</b>	<b>87.17</b>	<b>78.92</b>	<b>8.25</b>	<b>-3.06</b>
<b>S.Dev</b>	<b>11.57</b>	<b>15.58</b>	<b>11.45</b>	<b>10.71</b>	<b>10.04</b>

## Students Pulse Rate Before Math Exam 2 and the Average of the Pulse Rate Before Math Exam 2



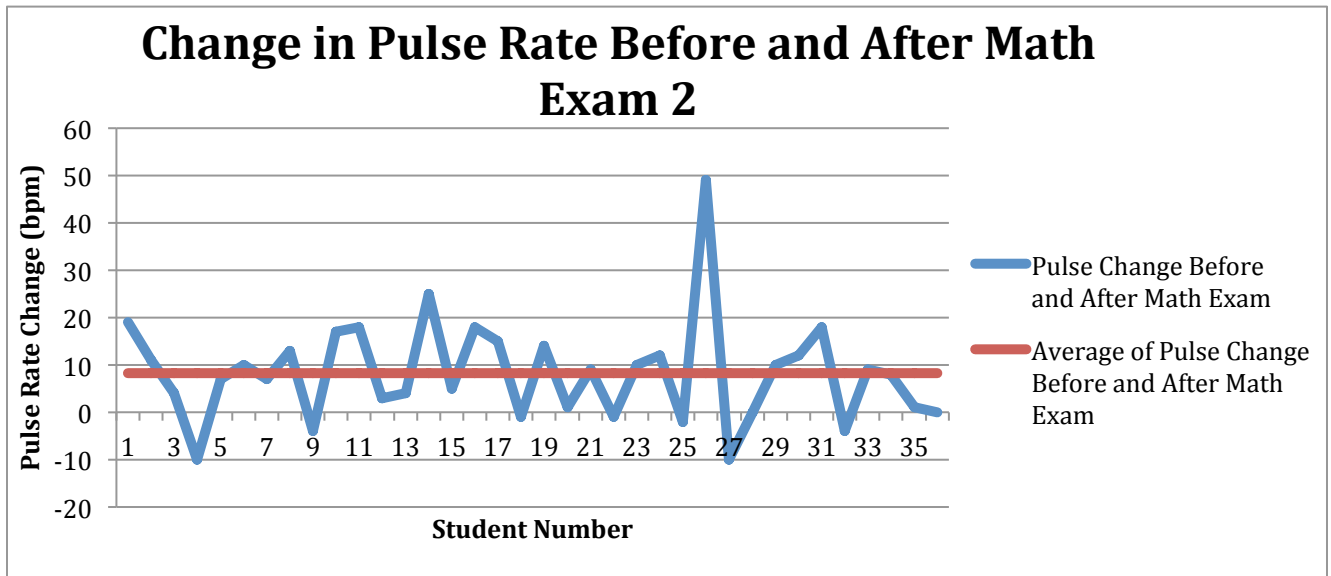
This graph is a comparison between each student's pulse rate before a second math exam and the average of all the readings taken before the math exam. This will show how each student's pulse rate before the exam varies from the average line.

## Students Pulse Rate After Math Exam 2 and Average of the Pulse Rate After Math Exam 2

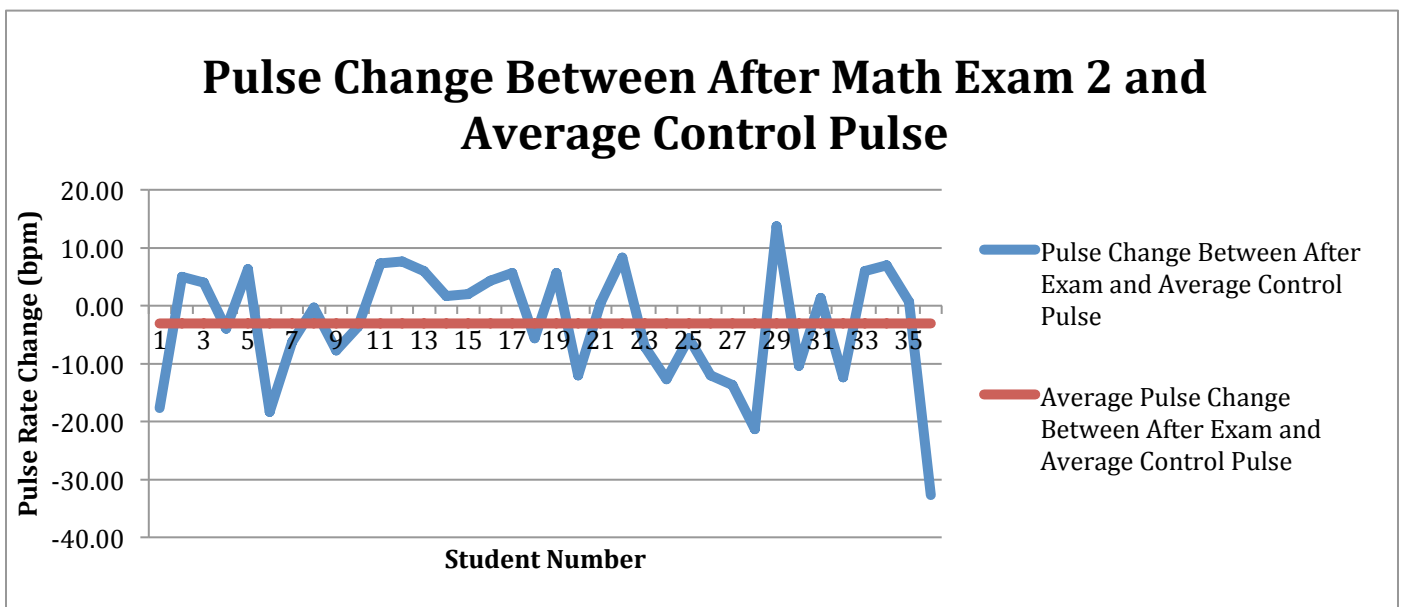


This graph is a comparison between each student's pulse rate after a second math exam and the average of every students reading after the math exam. This graph will show how each student's pulse was different from the average of all the readings taken after the math exam.





This graph shows the change in pulse rate for each student before and after the second math exam. It is being compared with the average change in pulse rate before and after the math exam for all the students.



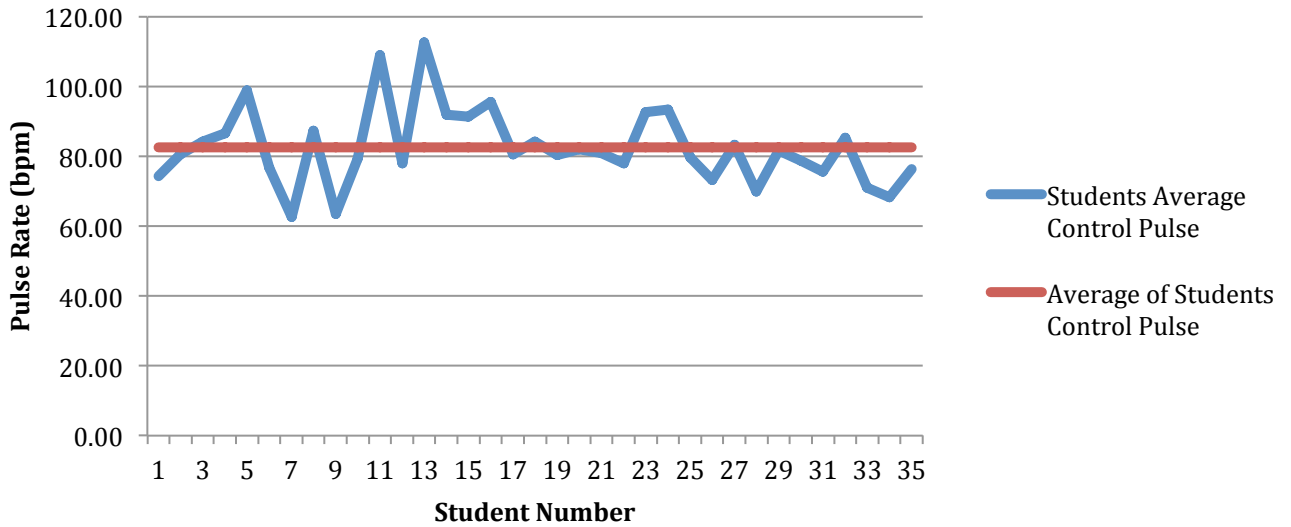
This graph shows the change between students pulse rates after the exam and their average control pulse. This will show whether or not a student's pulse rate returned back to normal after the math exam was completed.

## History Data Tables/ Graphs

Pulse Rates In History Class (Exam 1)

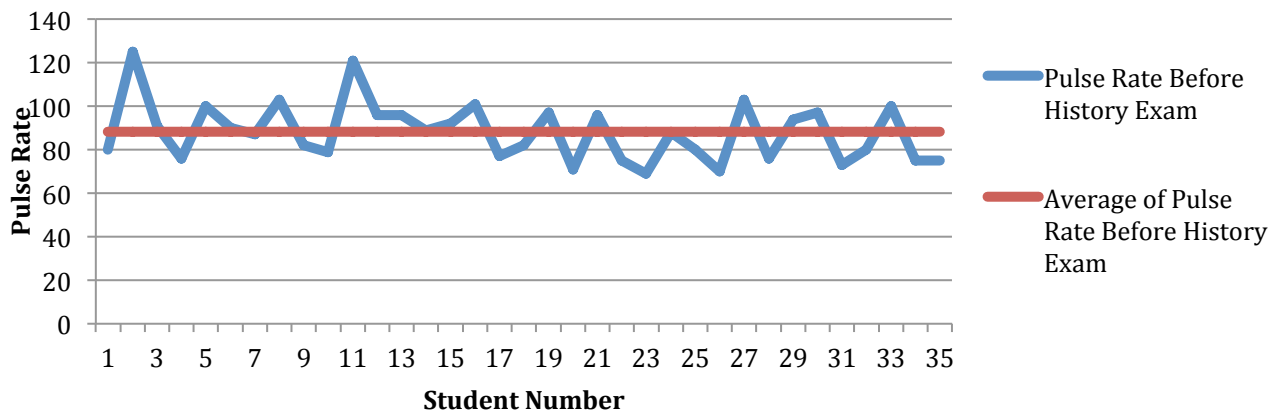
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	74.33	80	67	13	7.33
2	80.67	125	67	58	13.67
3	84.33	91	76	15	8.33
4	86.67	76	90	-14	-3.33
5	99.00	100	108	-8	-9.00
6	76.67	90	75	15	1.67
7	62.67	87	71	16	-8.33
8	87.33	103	81	22	6.33
9	63.50	82	79	3	-15.50
10	79.33	79	67	12	12.33
11	109.00	121	107	14	2.00
12	78.00	96	90	6	-12.00
13	112.67	96	80	16	32.67
14	92.00	89	74	15	18.00
15	91.33	92	62	30	29.33
16	95.67	101	91	10	4.67
17	80.67	77	67	10	13.67
18	84.33	82	74	8	10.33
19	80.33	97	98	-1	-17.67
20	82.00	71	81	-10	1.00
21	81.00	96	73	23	8.00
22	78.00	75	65	10	13.00
23	92.67	69	65	4	27.67
24	93.33	88	83	5	10.33
25	79.67	80	61	19	18.67
26	73.33	70	63	7	10.33
27	83.33	103	83	20	0.33
28	70.00	76	66	10	4.00
29	81.67	94	91	3	-9.33
30	78.67	97	70	27	8.67
31	75.67	73	77	-4	-1.33
32	85.33	80	83	-3	2.33
33	71.00	100	92	8	-21.00
34	68.33	75	92	-17	-23.67
35	76.33	75	161	-86	-84.67
<b>Average</b>	<b>82.54</b>	<b>88.17</b>	<b>80.86</b>	<b>7.31</b>	<b>1.68</b>
<b>S.Dev</b>	<b>10.83</b>	<b>13.36</b>	<b>18.35</b>	<b>20.93</b>	<b>19.82</b>

## Students Average Control Pulse Rate and the Average of Students Control Pulse (History)



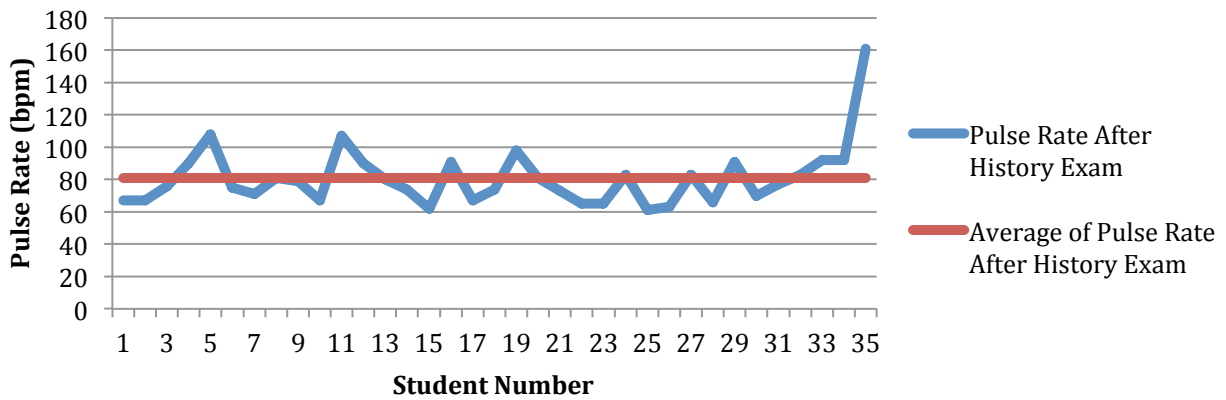
The graph shows each student's average control pulse rate. This was calculated by finding the average of the 3 control readings taken at school. The red line indicates the average of the each student's average control pulse.

## Students Pulse Rate Before History Exam and the Average of the Pulse Rate Before History Exam



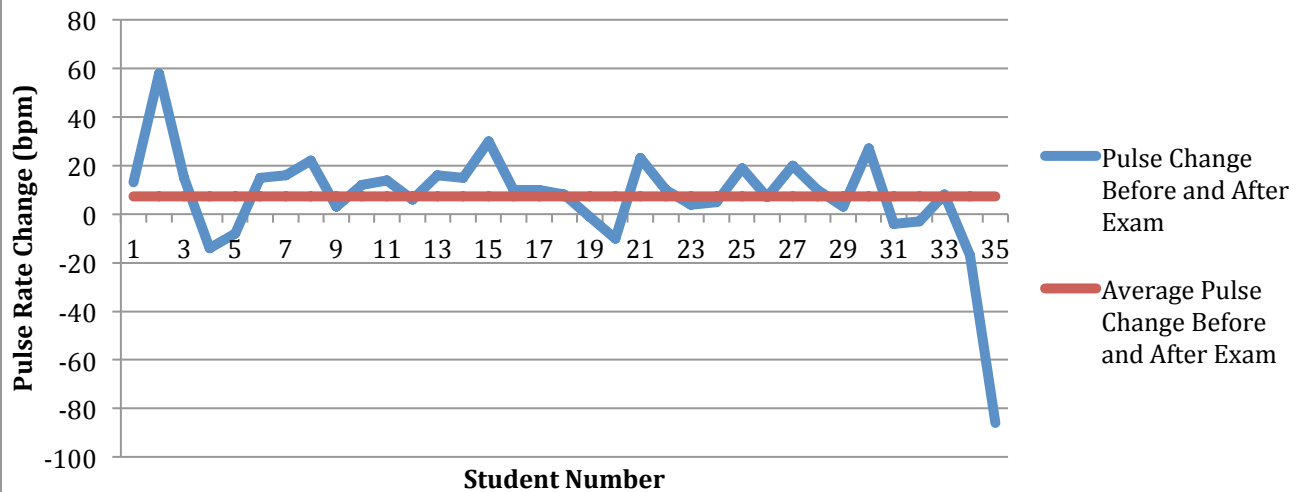
The graph shows each student's pulse rate before a history exam and it is being compared to the average of the overall average of every reading taken before the history exam.

## Students Pulse Rate After History Exam and Average of the Pulse Rate After History Exam

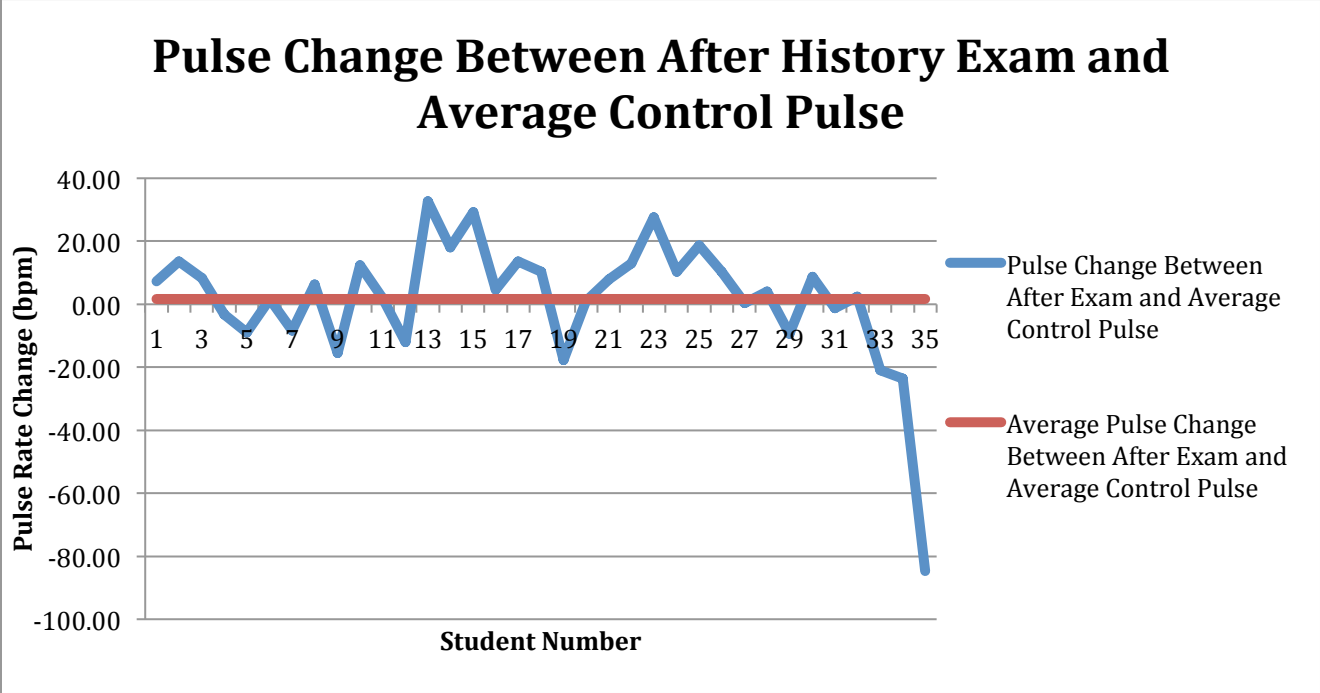


The graph shows each student's pulse rate after a history exam and the average of each student's reading. Each student's pulse rate is compared to the average line to see how much it varies.

## Change in Pulse Before and After History Exam



This graph shows the change in pulse rate before and after a history exam. Each student's pulse change from before and after the exam is being compared to the average of all those readings.

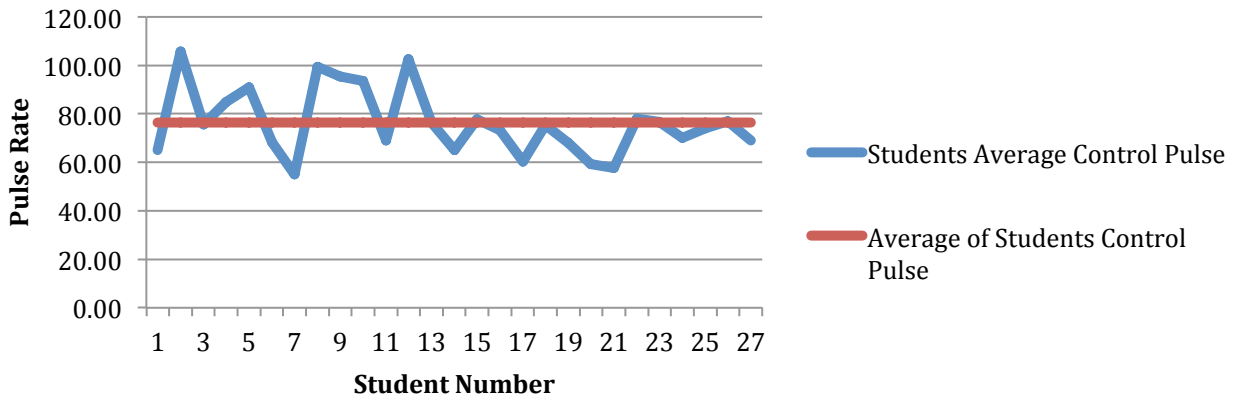


This graph shows the difference between students pulse rate after a history exam and their average control pulse. The red line is the average change among all the differences for each student.

## Spanish Data Tables/Graphs

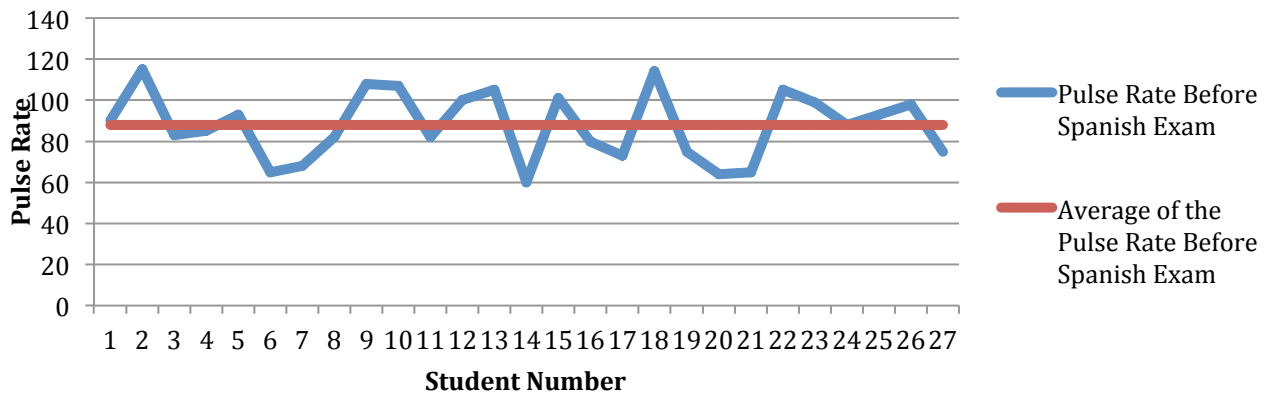
Pulse Rates In Spanish Class (Exam 1)					
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	65.00	90	70	20	-5.00
2	105.67	115	125	-10	-19.33
3	75.67	83	93	-10	-17.33
4	85.00	85	82	3	3.00
5	91.00	93	87	6	4.00
6	68.33	65	70	-5	-1.67
7	55.00	68	52	16	3.00
8	99.33	82	88	-6	11.33
9	95.33	108	102	6	-6.67
10	93.67	107	95	12	-1.33
11	69.00	82	78	4	-9.00
12	102.67	100	88	12	14.67
13	76.33	105	71	34	5.33
14	65.00	60	64	-4	1.00
15	77.67	101	110	-9	-32.33
16	73.33	80	80	0	-6.67
17	60.33	73	72	1	-11.67
18	75.33	114	88	26	-12.67
19	68.00	75	61	14	7.00
20	59.33	64	78	-14	-18.67
21	57.67	65	63	2	-5.33
22	78.00	105	69	36	9.00
23	76.67	99	76	23	0.67
24	70.00	88	75	13	-5.00
25	74.00	93	87	6	-13.00
26	77.00	98	94	4	-17.00
27	69.00	75	65	10	4.00
<b>Average</b>	<b>76.42</b>	<b>87.89</b>	<b>80.85</b>	<b>7.04</b>	<b>-4.43</b>
<b>S.Dev</b>	<b>13.52899419</b>	<b>15.96601329</b>	<b>15.75672391</b>	<b>12.81920285</b>	<b>10.71279179</b>

## Students Average Control Pulse Rate and the Average of Students Control Pulse (Spanish)



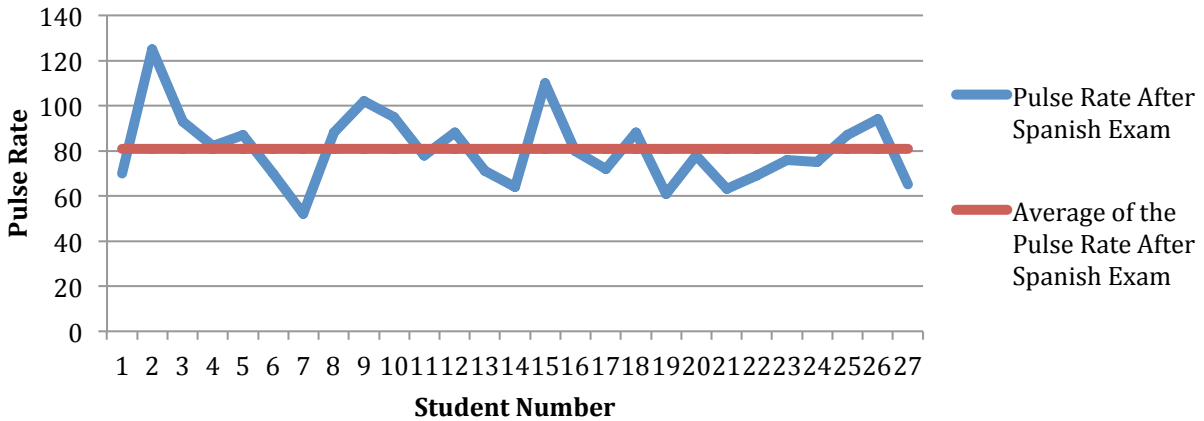
This graph shows each student's average control pulse. The red line shows the average of each student's average control pulse. This graph will show how each student's average resting pulse rate varies from the average of everyone's resting pulse rate.

## Students Pulse Rate Before Spanish Exam and the Average of the Pulse Rate Before Spanish Exam



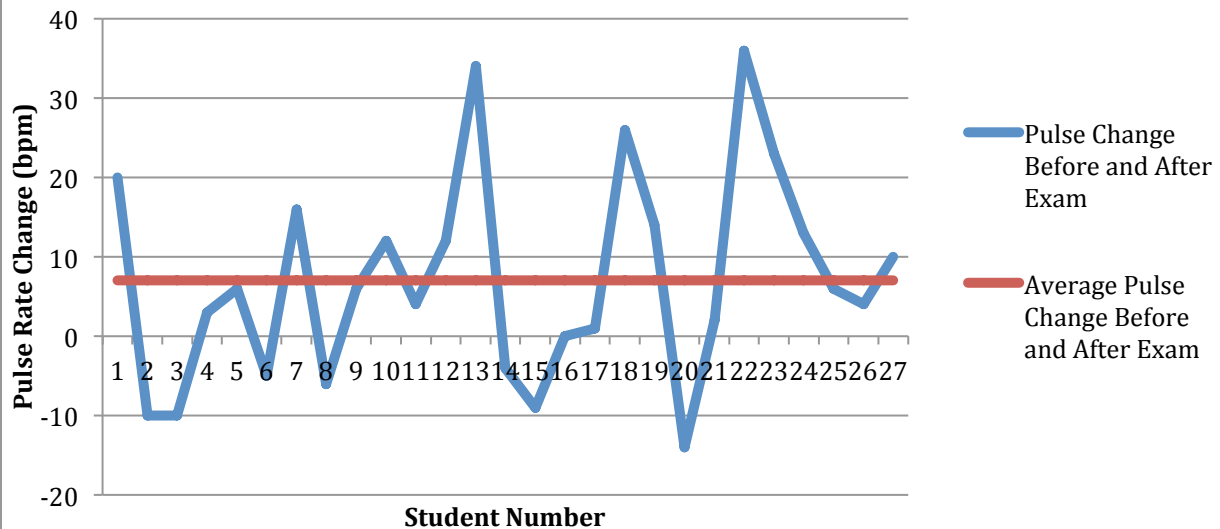
This graph shows each student's pulse rate before a Spanish exam and is being compared to the average of everyone's pulse rate before the Spanish exam.

## Students Pulse Rate After Spanish Exam and Average of the Pulse Rate After Spanish Exam



This graph shows each student's pulse rate after Spanish exam and is being compared to the average of everyone's pulse rate after the Spanish exam.

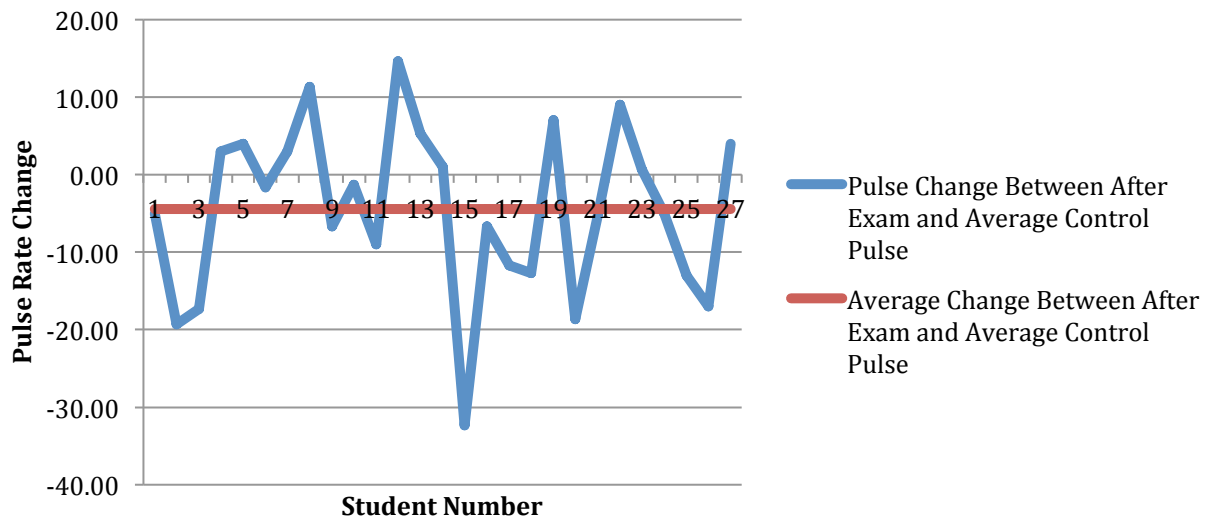
## Change in Pulse Before and After Spanish Exam



This graph shows the difference between each student's before and after pulse readings during the Spanish exam. The red line is the average change among all the students in the class.



## Pulse Change Between After Spanish Exam and Average Control Pulse

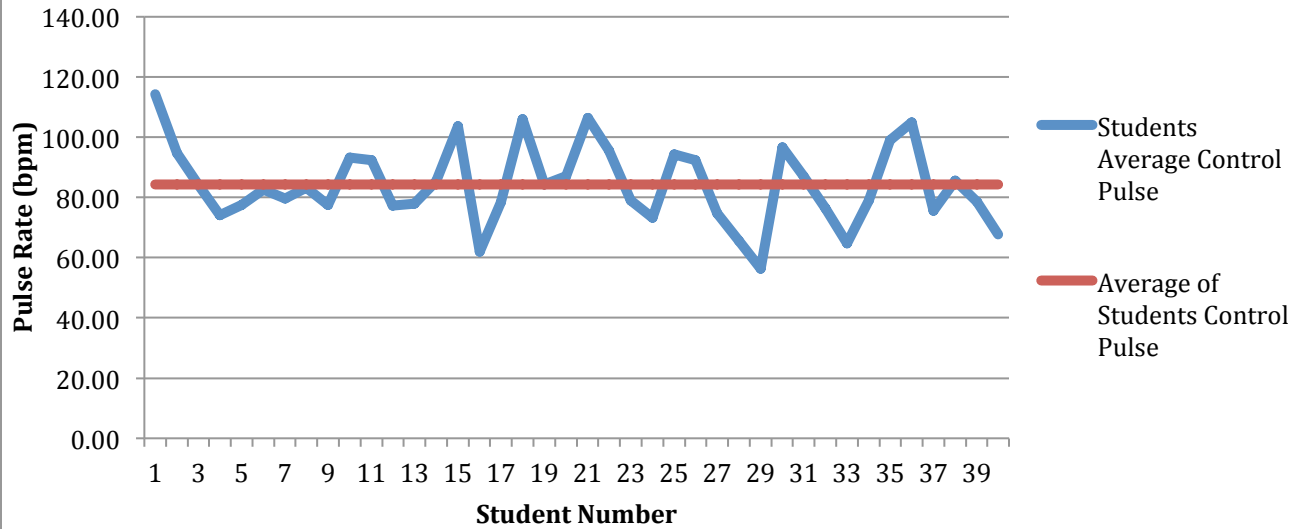


## Science Data Tables/ Graphs

Pulse Rates In Science Class (Exam 1)

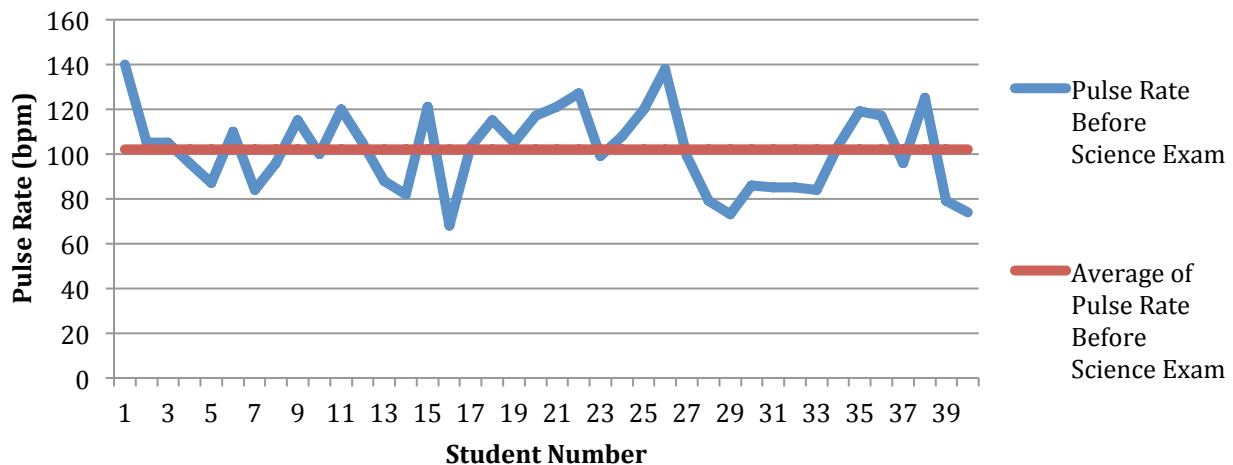
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	114.33	140	88	52	26.33
2	94.67	105	100	5	-5.33
3	84.33	105	85	20	-0.67
4	74.00	96	98	-2	-24.00
5	77.50	87	65	22	12.50
6	82.67	110	75	35	7.67
7	79.67	84	69	15	10.67
8	83.33	96	82	14	1.33
9	77.50	115	86	29	-8.50
10	93.33	100	68	32	25.33
11	92.33	120	83	37	9.33
12	77.33	105	70	35	7.33
13	78.00	88	78	10	0.00
14	85.33	82	113	-31	-27.67
15	103.67	121	111	10	-7.33
16	62.00	68	68	0	-6.00
17	78.33	103	80	23	-1.67
18	106.00	115	78	37	28.00
19	84.33	105	102	3	-17.67
20	87.00	117	102	15	-15.00
21	106.33	121	113	8	-6.67
22	95.67	127	106	21	-10.33
23	79.00	99	79	20	0.00
24	73.33	108	84	24	-10.67
25	94.33	120	100	20	-5.67
26	92.33	138	102	36	-9.67
27	74.67	99	66	33	8.67
28	65.67	79	65	14	0.67
29	56.33	73	79	-6	-22.67
30	96.67	86	102	-16	-5.33
31	87.00	85	77	8	10.00
32	76.50	85	92	-7	-15.50
33	64.67	84	78	6	-13.33
34	79.00	104	88	16	-9.00
35	99.00	119	117	2	-18.00
36	105.00	117	107	10	-2.00
37	75.67	96	78	18	-2.33
38	85.50	125	93	32	-7.50
39	78.67	79	79	0	-0.33
40	67.67	74	70	4	-2.33
<b>Averages</b>	<b>84.22</b>	<b>102.00</b>	<b>86.90</b>	<b>15.10</b>	<b>-2.68</b>
<b>S.Dev</b>	<b>12.91156889</b>	<b>17.85637141</b>	<b>14.92280135</b>	<b>16.21850795</b>	<b>12.6269003</b>

## Students Average Control Pulse Rate and the Average of Students Control Pulse (Science)



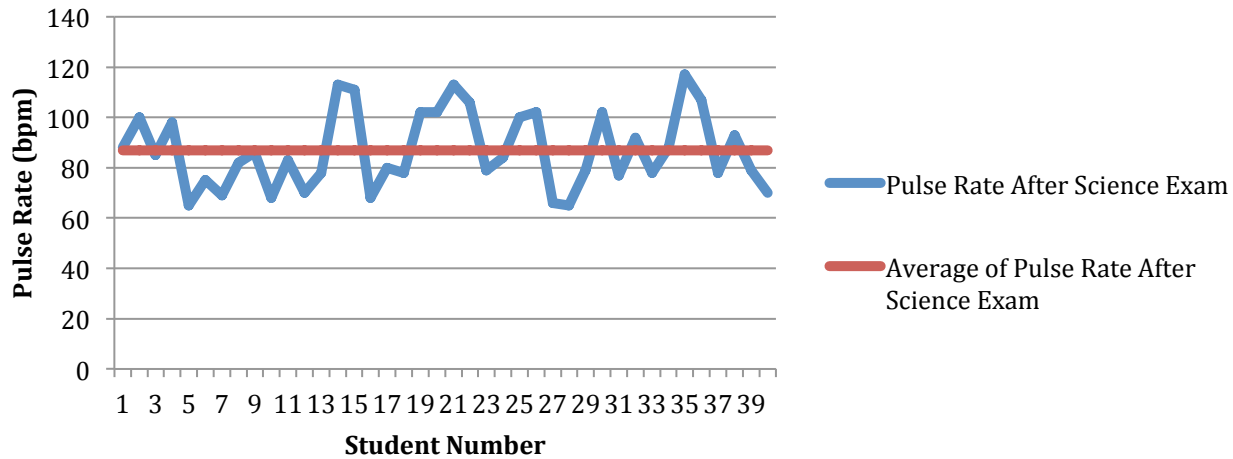
This graph shows each student's average control pulse rate and is being compared to the average of all the student's average control pulse rates.

## Students Pulse Rate Before Science Exam and the Average of the Pulse Rate Before Science Exam



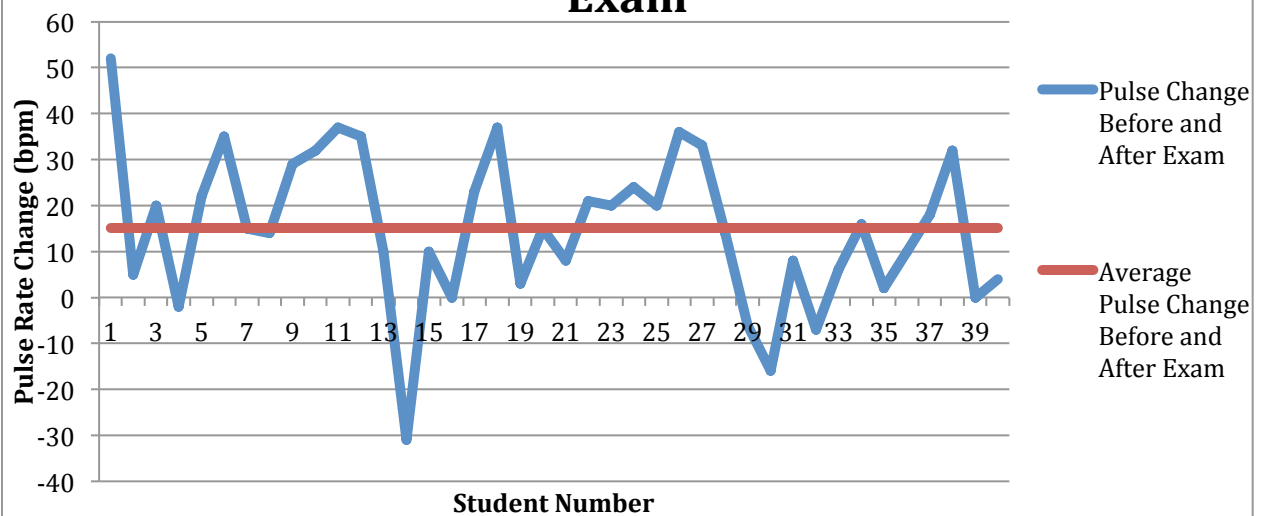
This graph shows each student's pulse rate before a science exam and is being compared to the overall average of the pulse rates taken before the exam.

## Students Pulse Rate After Science Exam and Average of the Pulse Rate After Science Exam

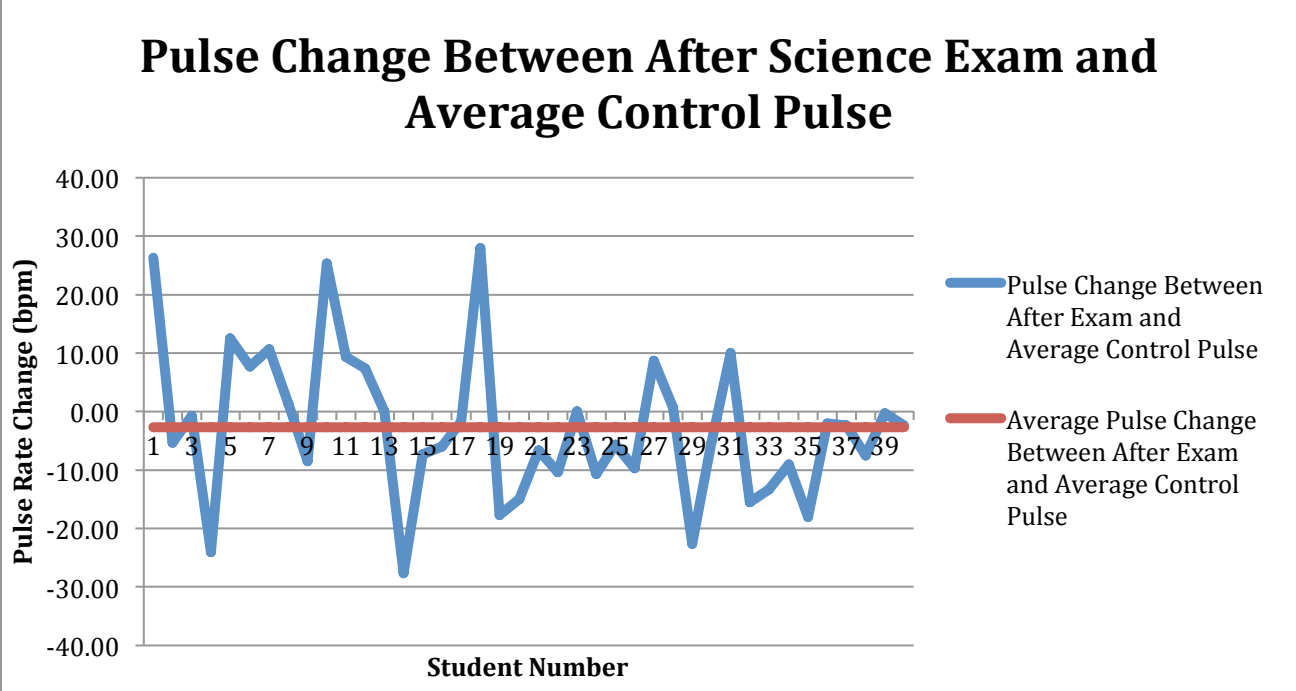


This graph is showing each student's pulse rate after the science exam is being compared to the overall of average of all the pulse rates taken after the science exam.

## Change in Pulse Before and After Science Exam



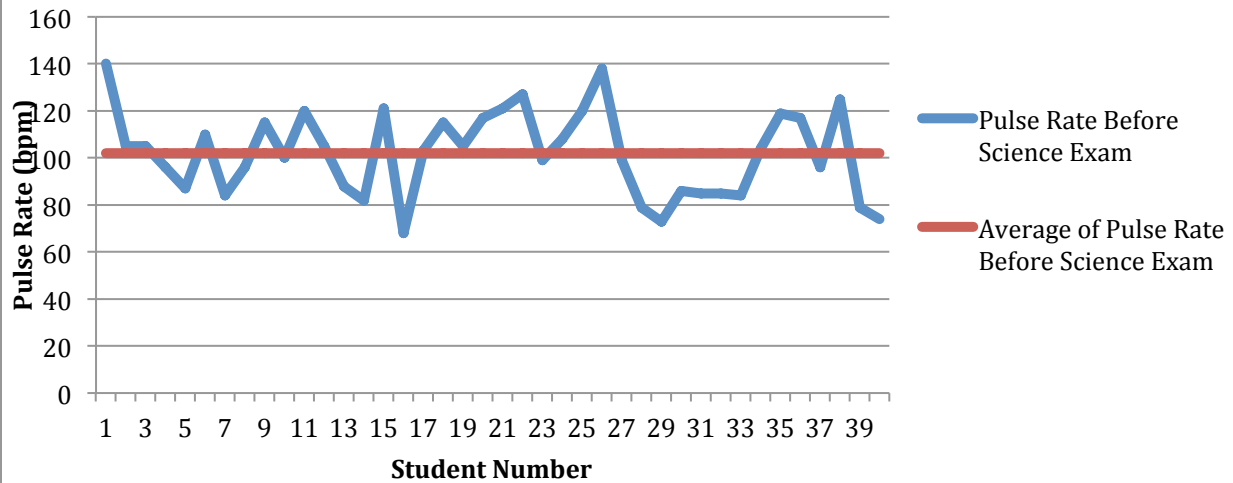
The graph shows each student's change in pulse rate before and after the science exam. The red line is the average of the all changes for each student in the class.



This graph shows each student's pulse rate change between after the science exam and their average control pulse rate. The red line is showing the average of the changes among all students in the class.

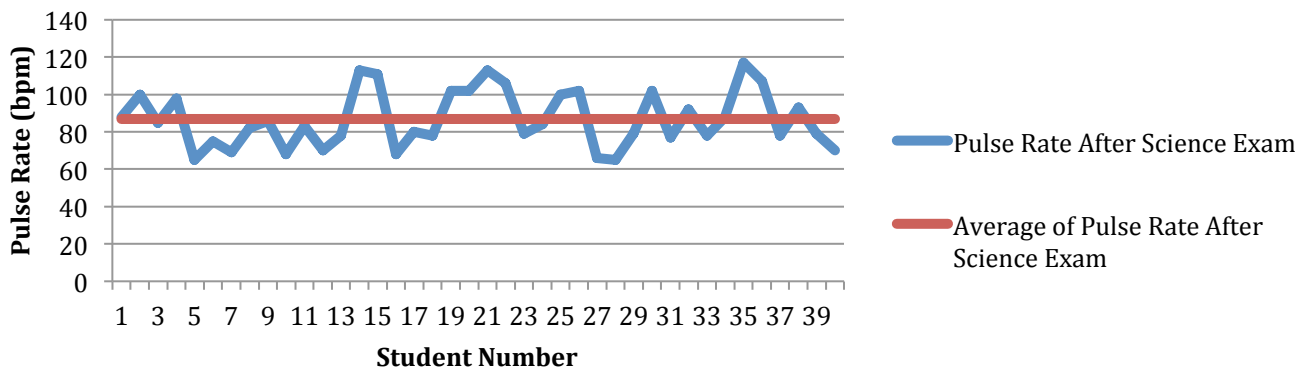
Pulse Rates In Science Class (Exam 2)					
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	114.33	145	118	27	-3.67
2	94.67	77	77	0	17.67
3	84.33	82	78	4	6.33
4	74.00	82	70	12	4.00
5	77.50	88	70	18	7.50
6	82.67	132	61	71	21.67
7	83.33	83	78	5	5.33
8	77.50	99	76	23	1.50
9	93.33	89	82	7	11.33
10	77.33	92	60	32	17.33
11	78.00	82	83	-1	-5.00
12	85.33	92	83	9	2.33
13	103.67	108	108	0	-4.33
14	62.00	65	65	0	-3.00
15	78.33	86	86	0	-7.67
16	106.00	73	80	-7	26.00
17	84.33	108	98	10	-13.67
18	87.00	110	100	10	-13.00
19	106.33	141	110	31	-3.67
20	93.67	99	100	-1	-6.33
21	95.67	105	86	19	9.67
22	79.00	90	105	-15	-26.00
23	73.33	94	67	27	6.33
24	94.33	117	96	21	-1.67
25	92.33	111	92	19	0.33
26	74.67	98	71	27	3.67
27	65.67	78	79	-1	-13.33
28	56.33	59	53	6	3.33
29	96.67	102	91	11	5.67
30	87.00	94	98	-4	-11.00
31	76.50	115	51	64	25.50
32	64.67	114	84	30	-19.33
33	88.33	111	87	24	1.33
34	79.00	88	75	13	4.00
35	99.00	109	80	29	19.00
36	105.00	88	83	5	22.00
37	75.67	100	98	2	-22.33
38	85.50	99	92	7	-6.50
39	78.67	97	85	12	-6.33
40	67.67	81	74	7	-6.33
<b>Average</b>	<b>84.47</b>	<b>97.08</b>	<b>83.25</b>	<b>13.83</b>	<b>1.22</b>
<b>S.Dev</b>	<b>12.92817767</b>	<b>18.03661207</b>	<b>15.05116275</b>	<b>16.88325724</b>	<b>12.43584648</b>

## Students Pulse Rate Before Science Exam 2 and the Average of the Pulse Rate Before Science Exam 2



This graph shows each student's pulse rate before another science exam and is being compared to the average of everyone's pulse rate before the exam.

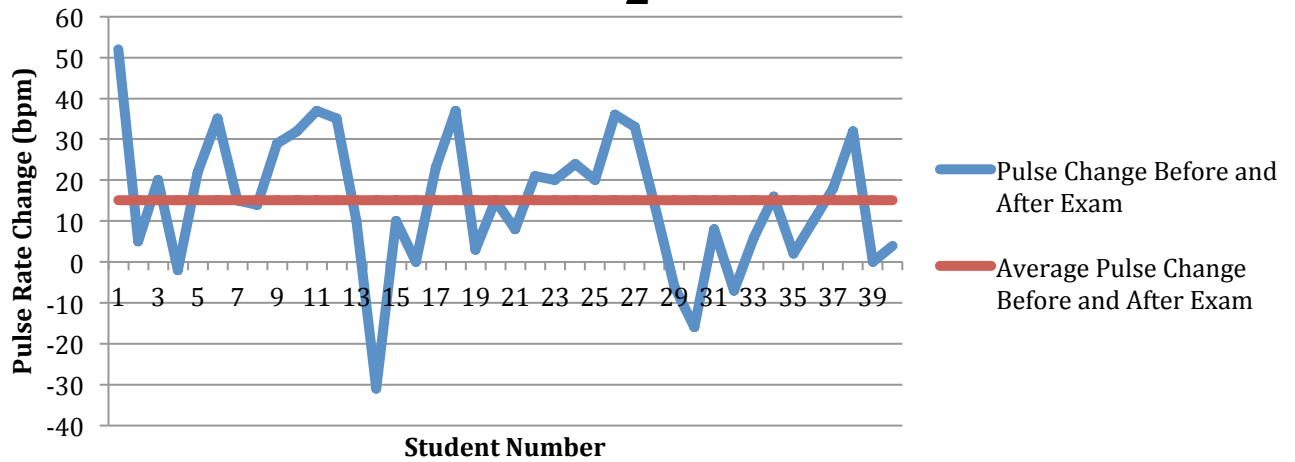
## Students Pulse Rate After Science Exam 2 and Average of the Pulse Rate After Science Exam 2



This graph shows each student's pulse rate after the science exam and is being compared to the average pulse rate after the exam of all the student's in the science class.

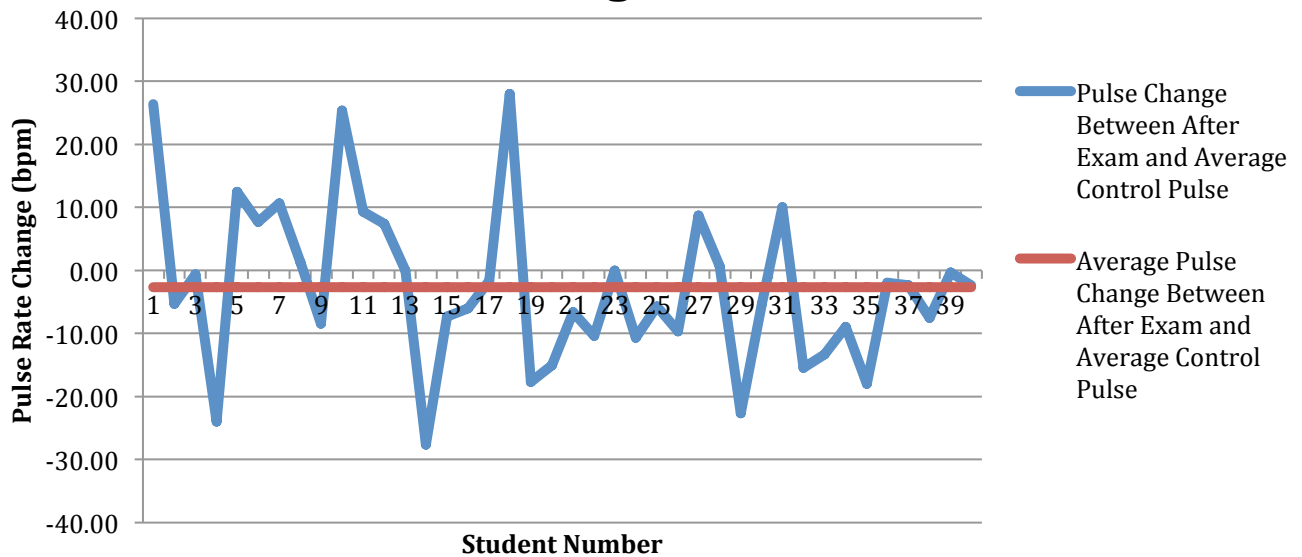
## Change in Pulse Before and After Science Exam

2



This graph shows each student's difference in pulse rate from before and after the science exam. The red line indicates the average of the overall change among all the student's.

## Pulse Change Between After Science Exam 2 and Average Control Pulse



This graph shows the change in pulse rate from after the science exam and the average control pulse. The red line is the average change from after the science exam and the average control pulse among all students in the class.



### Other Data Tables/Graphs

Pulse Rate Across all Subjects

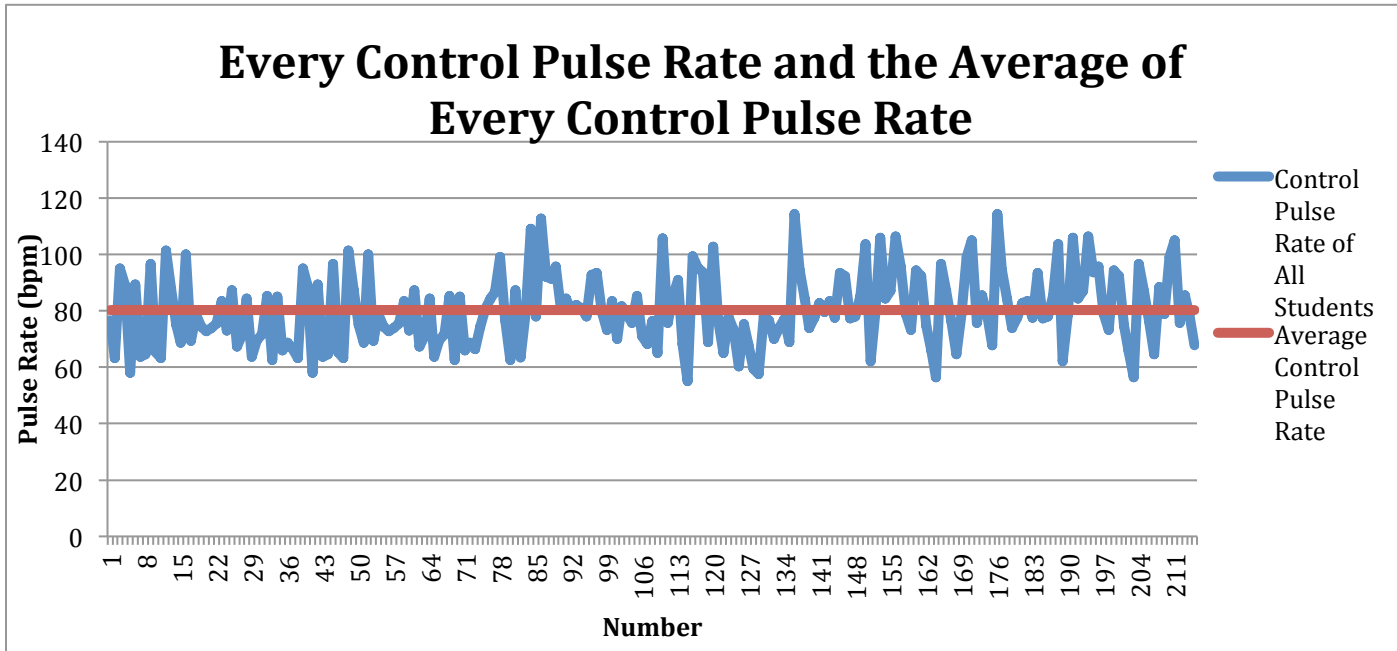
Student #	Average Control Pulse Rate	Pulse Rate Before Exam	Pulse Rate After Exam	Difference in Pulse Rate Before and After Exam	Difference in Average Control Pulse and Pulse Rate After Exam
1	76.67	85.00	75.00	10.00	1.67
2	63.33	64.00	71.00	-7.00	-7.67
3	95.00	90.00	83.00	7.00	12.00
4	89.00	89.00	84.00	5.00	5.00
5	58.00	50.00	60.00	-10.00	-2.00
6	89.33	105.00	101.00	4.00	-11.67
7	63.67	65.00	66.00	-1.00	-2.33
8	64.67	67.00	70.00	-3.00	-5.33
9	96.67	112.00	90.00	22.00	6.67
10	65.33	83.00	75.00	8.00	-9.67
11	63.33	62.00	88.00	-26.00	-24.67
12	101.33	87.00	73.00	14.00	28.33
13	87.67	94.00	90.00	4.00	-2.33
14	75.00	87.00	90.00	-3.00	-15.00
15	68.67	86.00	62.00	24.00	6.67
16	100.00	111.00	96.00	15.00	4.00
17	69.33	77.00	66.00	11.00	3.33
18	78.67	85.00	79.00	6.00	-0.33
19	74.33	80.00	75.00	5.00	-0.67
20	72.67	81.00	71.00	10.00	1.67
21	74.00	78.00	68.00	10.00	6.00
22	75.50	74.00	67.00	7.00	8.50
23	83.33	63.00	60.00	3.00	23.33
24	73.00	85.00	88.00	-3.00	-15.00
25	87.33	102.00	90.00	12.00	-2.67
26	67.33	83.00	74.00	9.00	-6.67
27	71.00	82.00	74.00	8.00	-3.00
28	84.33	91.00	97.00	-6.00	-12.67
29	63.67	86.00	58.00	28.00	5.67
30	69.67	70.00	70.00	0.00	-0.33
31	71.67	85.00	77.00	8.00	-5.33
32	85.33	88.00	77.00	11.00	8.33
33	62.67	66.00	54.00	12.00	8.67
34	85.00	106.00	83.00	23.00	2.00
35	66.00	73.00	63.00	10.00	3.00
36	68.67	76.00	61.00	15.00	7.67
37	66.33	87.00	75.00	12.00	-8.67
38	63.33	100.00	81.00	19.00	-17.67
39	95.00	101.00	90.00	11.00	5.00

40	89.00	89.00	85.00	4.00	4.00
41	58.00	52.00	62.00	-10.00	-4.00
42	89.33	90.00	83.00	7.00	6.33
43	63.67	92.00	82.00	10.00	-18.33
44	64.67	78.00	71.00	7.00	-6.33
45	96.67	110.00	97.00	13.00	-0.33
46	65.33	69.00	73.00	-4.00	-7.67
47	63.33	84.00	67.00	17.00	-3.67
48	101.33	112.00	94.00	18.00	7.33
49	87.67	83.00	80.00	3.00	7.67
50	75.00	73.00	69.00	4.00	6.00
51	68.67	92.00	67.00	25.00	1.67
52	100.00	103.00	98.00	5.00	2.00
53	69.33	83.00	65.00	18.00	4.33
54	78.67	88.00	73.00	15.00	5.67
55	74.33	79.00	80.00	-1.00	-5.67
56	72.67	81.00	67.00	14.00	5.67
57	74.00	87.00	86.00	1.00	-12.00
58	75.50	84.00	75.00	9.00	0.50
59	83.33	74.00	75.00	-1.00	8.33
60	73.00	90.00	80.00	10.00	-7.00
61	87.33	112.00	100.00	12.00	-12.67
62	67.33	71.00	73.00	-2.00	-5.67
63	71.00	132.00	83.00	49.00	-12.00
64	84.33	88.00	98.00	-10.00	-13.67
65	63.67	85.00	85.00	0.00	-21.33
66	69.67	66.00	56.00	10.00	13.67
67	71.67	94.00	82.00	12.00	-10.33
68	85.33	102.00	84.00	18.00	1.33
69	62.67	71.00	75.00	-4.00	-12.33
70	85.00	88.00	79.00	9.00	6.00
71	66.00	67.00	59.00	8.00	7.00
72	68.67	69.00	68.00	1.00	0.67
73	66.33	99.00	99.00	0.00	-32.67
74	74.33	80.00	67.00	13.00	7.33
75	80.67	125.00	67.00	58.00	13.67
76	84.33	91.00	76.00	15.00	8.33
77	86.67	76.00	90.00	-14.00	-3.33
78	99.00	100.00	108.00	-8.00	-9.00
79	76.67	90.00	75.00	15.00	1.67
80	62.67	87.00	71.00	16.00	-8.33
81	87.33	103.00	81.00	22.00	6.33
82	63.50	82.00	79.00	3.00	-15.50
83	79.33	79.00	67.00	12.00	12.33
84	109.00	121.00	107.00	14.00	2.00

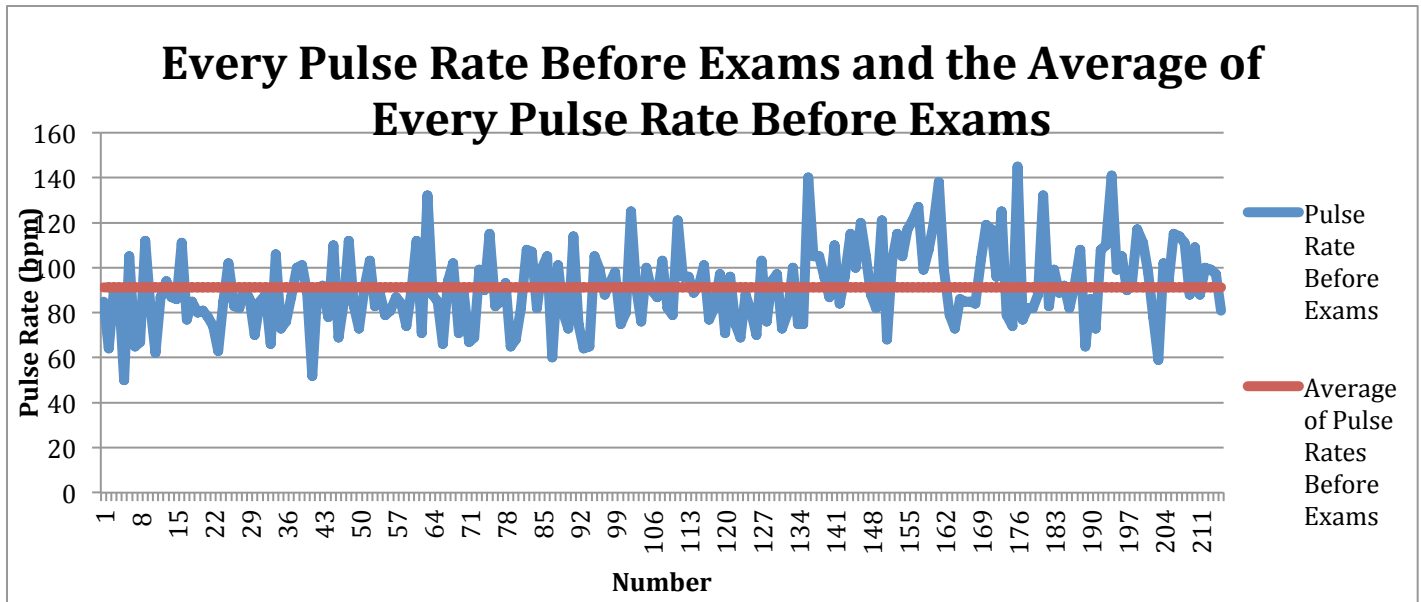
85	78.00	96.00	90.00	6.00	-12.00
86	112.67	96.00	80.00	16.00	32.67
87	92.00	89.00	74.00	15.00	18.00
88	91.33	92.00	62.00	30.00	29.33
89	95.67	101.00	91.00	10.00	4.67
90	80.67	77.00	67.00	10.00	13.67
91	84.33	82.00	74.00	8.00	10.33
92	80.33	97.00	98.00	-1.00	-17.67
93	82.00	71.00	81.00	-10.00	1.00
94	81.00	96.00	73.00	23.00	8.00
95	78.00	75.00	65.00	10.00	13.00
96	92.67	69.00	65.00	4.00	27.67
97	93.33	88.00	83.00	5.00	10.33
98	79.67	80.00	61.00	19.00	18.67
99	73.33	70.00	63.00	7.00	10.33
100	83.33	103.00	83.00	20.00	0.33
101	70.00	76.00	66.00	10.00	4.00
102	81.67	94.00	91.00	3.00	-9.33
103	78.67	97.00	70.00	27.00	8.67
104	75.67	73.00	77.00	-4.00	-1.33
105	85.33	80.00	83.00	-3.00	2.33
106	71.00	100.00	92.00	8.00	-21.00
107	68.33	75.00	92.00	-17.00	-23.67
108	76.33	75.00	161.00	-86.00	-84.67
109	65.00	90.00	70.00	20.00	-5.00
110	105.67	115.00	125.00	-10.00	-19.33
111	75.67	83.00	93.00	-10.00	-17.33
112	85.00	85.00	82.00	3.00	3.00
113	91.00	93.00	87.00	6.00	4.00
114	68.33	65.00	70.00	-5.00	-1.67
115	55.00	68.00	52.00	16.00	3.00
116	99.33	82.00	88.00	-6.00	11.33
117	95.33	108.00	102.00	6.00	-6.67
118	93.67	107.00	95.00	12.00	-1.33
119	69.00	82.00	78.00	4.00	-9.00
120	102.67	100.00	88.00	12.00	14.67
121	76.33	105.00	71.00	34.00	5.33
122	65.00	60.00	64.00	-4.00	1.00
123	77.67	101.00	110.00	-9.00	-32.33
124	73.33	80.00	80.00	0.00	-6.67
125	60.33	73.00	72.00	1.00	-11.67
126	75.33	114.00	88.00	26.00	-12.67
127	68.00	75.00	61.00	14.00	7.00
128	59.33	64.00	78.00	-14.00	-18.67
129	57.67	65.00	63.00	2.00	-5.33

130	78.00	105.00	69.00	36.00	9.00
131	76.67	99.00	76.00	23.00	0.67
132	70.00	88.00	75.00	13.00	-5.00
133	74.00	93.00	87.00	6.00	-13.00
134	77.00	98.00	94.00	4.00	-17.00
135	69.00	75.00	65.00	10.00	4.00
136	114.33	140.00	88.00	52.00	26.33
137	94.67	105.00	100.00	5.00	-5.33
138	84.33	105.00	85.00	20.00	-0.67
139	74.00	96.00	98.00	-2.00	-24.00
140	77.50	87.00	65.00	22.00	12.50
141	82.67	110.00	75.00	35.00	7.67
142	79.67	84.00	69.00	15.00	10.67
143	83.33	96.00	82.00	14.00	1.33
144	77.50	115.00	86.00	29.00	-8.50
145	93.33	100.00	68.00	32.00	25.33
146	92.33	120.00	83.00	37.00	9.33
147	77.33	105.00	70.00	35.00	7.33
148	78.00	88.00	78.00	10.00	0.00
149	85.33	82.00	113.00	-31.00	-27.67
150	103.67	121.00	111.00	10.00	-7.33
151	62.00	68.00	68.00	0.00	-6.00
152	78.33	103.00	80.00	23.00	-1.67
153	106.00	115.00	78.00	37.00	28.00
154	84.33	105.00	102.00	3.00	-17.67
155	87.00	117.00	102.00	15.00	-15.00
156	106.33	121.00	113.00	8.00	-6.67
157	95.67	127.00	106.00	21.00	-10.33
158	79.00	99.00	79.00	20.00	0.00
159	73.33	108.00	84.00	24.00	-10.67
160	94.33	120.00	100.00	20.00	-5.67
161	92.33	138.00	102.00	36.00	-9.67
162	74.67	99.00	66.00	33.00	8.67
163	65.67	79.00	65.00	14.00	0.67
164	56.33	73.00	79.00	-6.00	-22.67
165	96.67	86.00	102.00	-16.00	-5.33
166	87.00	85.00	77.00	8.00	10.00
167	76.50	85.00	92.00	-7.00	-15.50
168	64.67	84.00	78.00	6.00	-13.33
169	79.00	104.00	88.00	16.00	-9.00
170	99.00	119.00	117.00	2.00	-18.00
171	105.00	117.00	107.00	10.00	-2.00
172	75.67	96.00	78.00	18.00	-2.33
173	85.50	125.00	93.00	32.00	-7.50
174	78.67	79.00	79.00	0.00	-0.33

175	67.67	74.00	70.00	4.00	-2.33
176	114.33	145.00	118.00	27.00	-3.67
177	94.67	77.00	77.00	0.00	17.67
178	84.33	82.00	78.00	4.00	6.33
179	74.00	82.00	70.00	12.00	4.00
180	77.50	88.00	70.00	18.00	7.50
181	82.67	132.00	61.00	71.00	21.67
182	83.33	83.00	78.00	5.00	5.33
183	77.50	99.00	76.00	23.00	1.50
184	93.33	89.00	82.00	7.00	11.33
185	77.33	92.00	60.00	32.00	17.33
186	78.00	82.00	83.00	-1.00	-5.00
187	85.33	92.00	83.00	9.00	2.33
188	103.67	108.00	108.00	0.00	-4.33
189	62.00	65.00	65.00	0.00	-3.00
190	78.33	86.00	86.00	0.00	-7.67
191	106.00	73.00	80.00	-7.00	26.00
192	84.33	108.00	98.00	10.00	-13.67
193	87.00	110.00	100.00	10.00	-13.00
194	106.33	141.00	110.00	31.00	-3.67
195	93.67	99.00	100.00	-1.00	-6.33
196	95.67	105.00	86.00	19.00	9.67
197	79.00	90.00	105.00	-15.00	-26.00
198	73.33	94.00	67.00	27.00	6.33
199	94.33	117.00	96.00	21.00	-1.67
200	92.33	111.00	92.00	19.00	0.33
201	74.67	98.00	71.00	27.00	3.67
202	65.67	78.00	79.00	-1.00	-13.33
203	56.33	59.00	53.00	6.00	3.33
204	96.67	102.00	91.00	11.00	5.67
205	87.00	94.00	98.00	-4.00	-11.00
206	76.50	115.00	51.00	64.00	25.50
207	64.67	114.00	84.00	30.00	-19.33
208	88.33	111.00	87.00	24.00	1.33
209	79.00	88.00	75.00	13.00	4.00
210	99.00	109.00	80.00	29.00	19.00
211	105.00	88.00	83.00	5.00	22.00
212	75.67	100.00	98.00	2.00	-22.33
213	85.50	99.00	92.00	7.00	-6.50
214	78.67	97.00	85.00	12.00	-6.33
215	67.67	81.00	74.00	7.00	-6.33
<b>Average</b>	<b>80.18</b>	<b>91.23</b>	<b>81.21</b>	<b>10.02</b>	<b>-1.04</b>
<b>S.Dev</b>	<b>12.82</b>	<b>17.34</b>	<b>15.11</b>	<b>15.57</b>	<b>13.27</b>

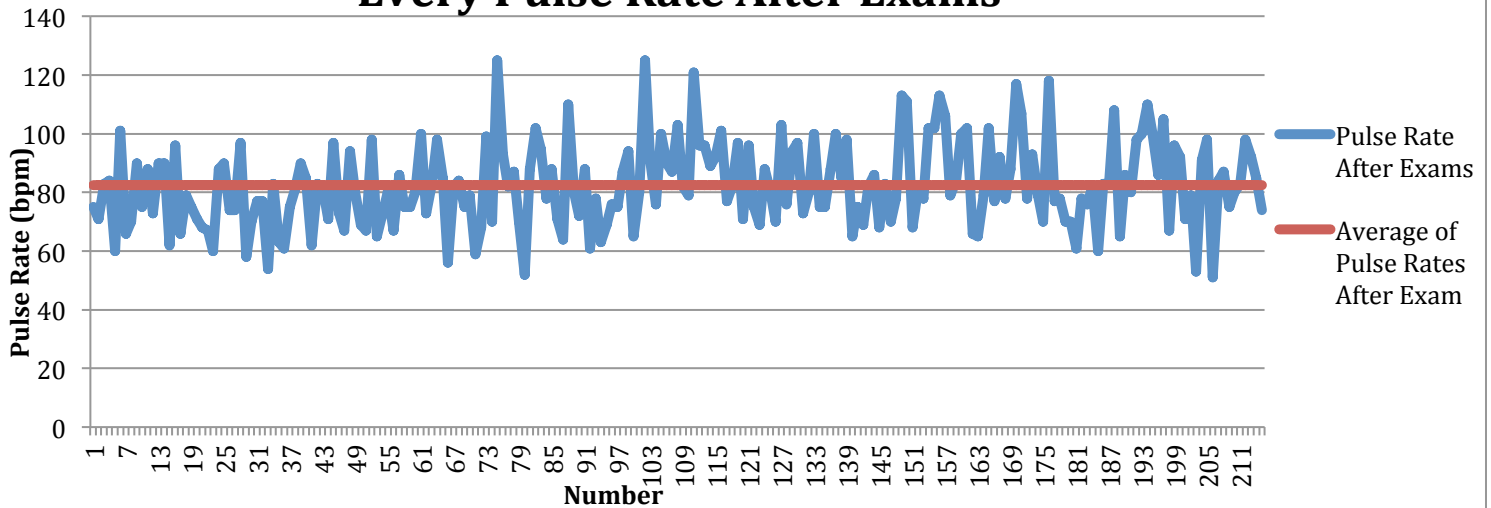


This graph shows every pulse rate taken during experimentation and is being compared with the average of all the control readings taken.



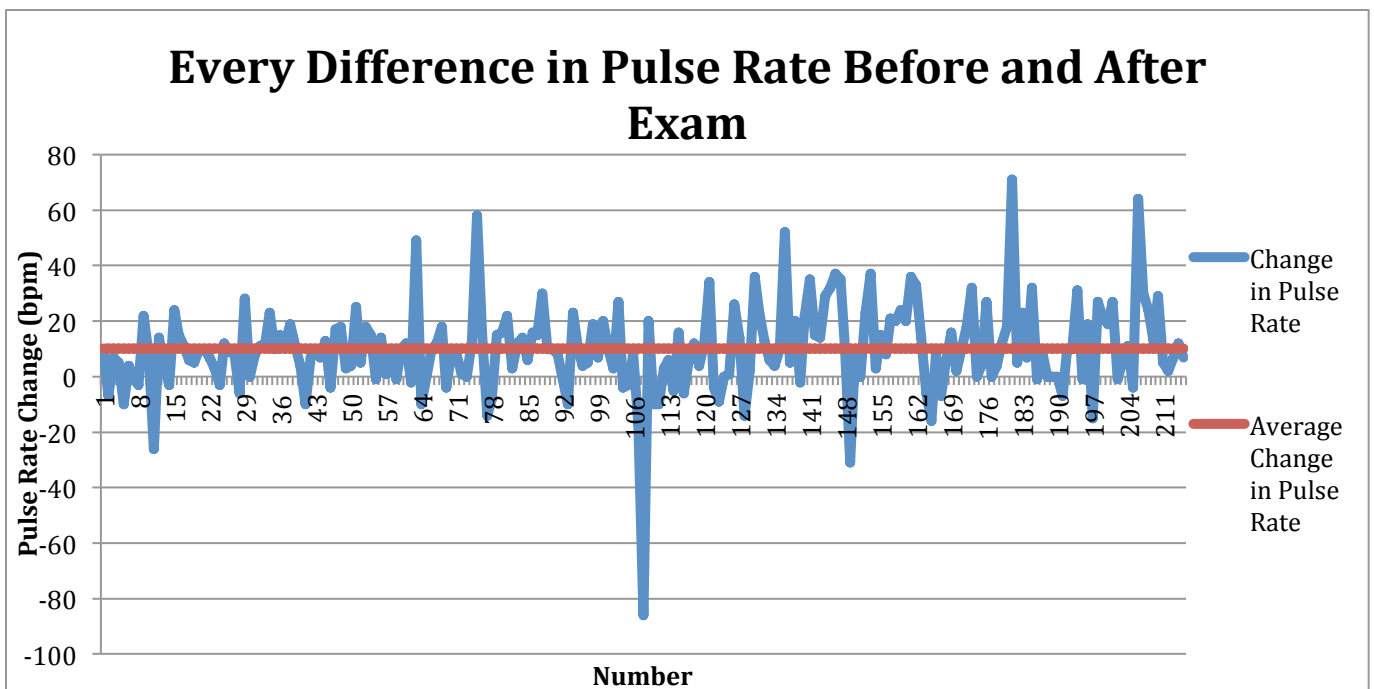
This graph shows every pulse rate taken before the exams and is being compared to the average of every pulse rate taken before exams. The red line shows the average of all the pulse rates taken before exams.

## Every Pulse Rate After Exams and the Average of Every Pulse Rate After Exams

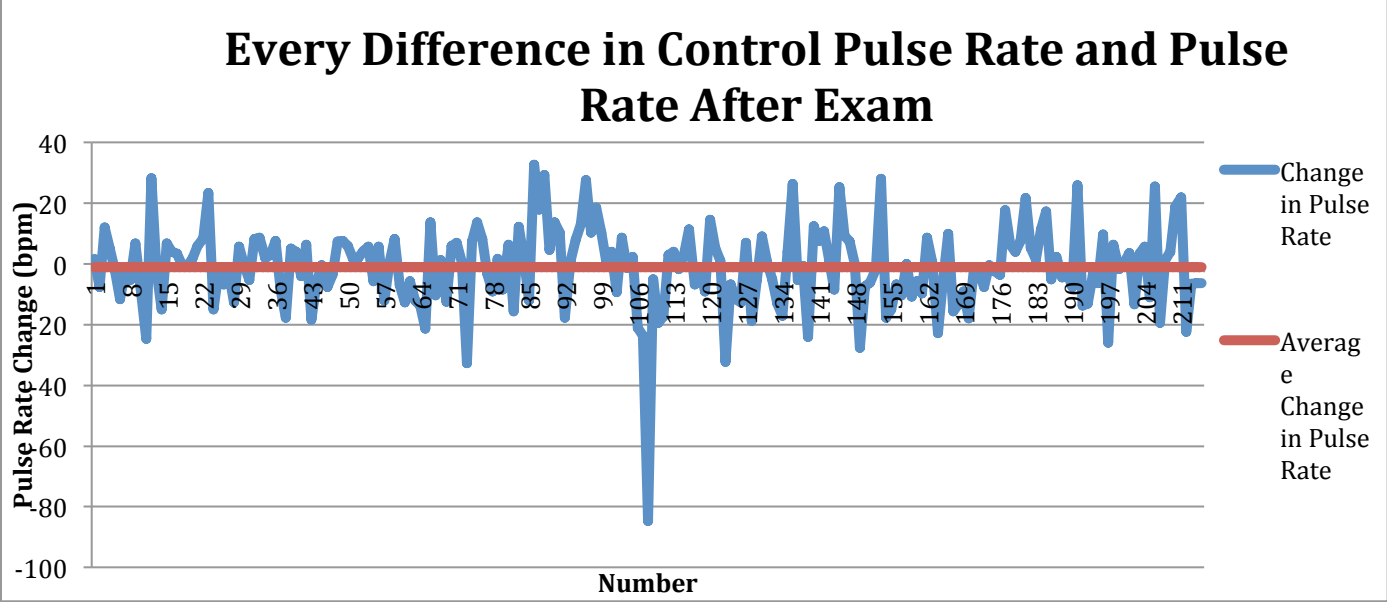


This graph shows every pulse rate taken after exams and is being compared to the average of all pulse rates taken after the exams. The red line is the average of all pulse rates taken after the exam.

## Every Difference in Pulse Rate Before and After Exam



This graph shows every difference between before and after exams. It is being compared with the average change in pulse rate before and after exams.



This graph shows the change in pulse rate between control pulse rates and each pulse rate after exams. It is being compared to the average change between the control pulse rates and pulse rates after exams.



SpO2 Across all Subjects					
Student #	Average Control SpO2	SpO2 Before Exam	SpO2 After Exam	Difference in SpO2 Before and After Exam	Difference in Average Control SpO2 and SpO2 After Exam
1	99.00	99	100	-1	-1.00
2	98.33	98	98	0	0.33
3	99.33	98	85	13	14.33
4	98.67	98	99	-1	-0.33
5	98.00	98	99	-1	-1.00
6	97.67	94	99	-5	-1.33
7	98.00	97	98	-1	0.00
8	99.00	98	89	9	10.00
9	98.67	96	91	5	7.67
10	99.67	98	97	1	2.67
11	98.67	98	99	-1	-0.33
12	98.33	98	98	0	0.33
13	98.33	98	100	-2	-1.67
14	98.67	98	99	-1	-0.33
15	98.00	97	99	-2	-1.00
16	97.67	98	99	-1	-1.33
17	98.00	98	88	10	10.00
18	98.67	98	98	0	0.67
19	99.00	99	100	-1	-1.00
20	98.67	98	99	-1	-0.33
21	98.33	99	98	1	0.33
22	98.67	98	98	0	0.67
23	97.33	98	98	0	-0.67
24	98.67	99	99	0	-0.33
25	98.67	99	99	0	-0.33
26	98.67	99	98	1	0.67
27	98.33	98	100	-2	-1.67
28	99.00	92	96	-4	3.00
29	98.33	99	100	-1	-1.67
30	99.50	99	100	-1	-0.50
31	98.50	100	100	0	-1.50
32	98.50	98	100	-2	-1.50
33	92.67	98	100	-2	-7.33
34	96.67	98	99	-1	-2.33
35	99.00	96	99	-3	0.00
36	96.67	98	96	2	0.67
37	98.67	97	97	0	1.67
38	98.33	94	95	-1	3.33
39	97.00	99	99	0	-2.00
40	97.67	100	84	16	13.67

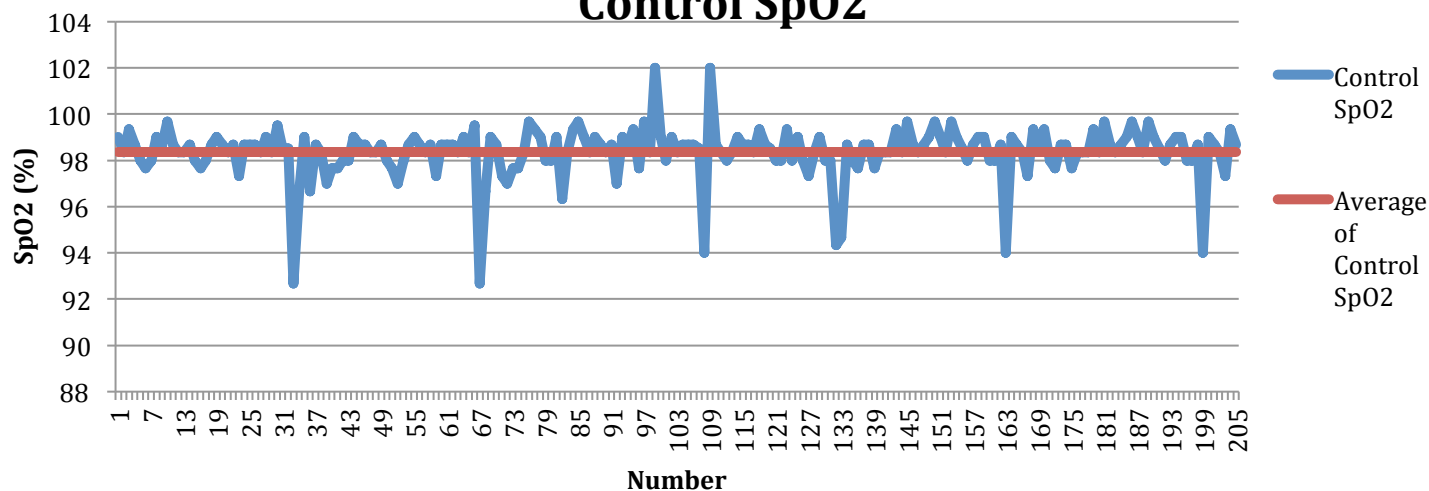
41	97.67	99	99	0	-1.33
42	98.00	97	99	-2	-1.00
43	98.00	97	99	-2	-1.00
44	99.00	99	99	0	0.00
45	98.67	99	98	1	0.67
46	98.67	95	99	-4	-0.33
47	98.33	99	99	0	-0.67
48	98.33	98	99	-1	-0.67
49	98.67	90	100	-10	-1.33
50	98.00	99	98	1	0.00
51	97.67	98	98	0	-0.33
52	97.00	98	91	7	6.00
53	98.00	98	97	1	1.00
54	98.67	99	98	1	0.67
55	99.00	99	98	1	1.00
56	98.67	99	99	0	-0.33
57	98.33	98	100	-2	-1.67
58	98.67	98	99	-1	-0.33
59	97.33	99	99	0	-1.67
60	98.67	100	100	0	-1.33
61	98.67	99	99	0	-0.33
62	98.67	98	99	-1	-0.33
63	98.33	100	99	1	-0.67
64	99.00	100	99	1	0.00
65	98.33	93	98	-5	0.33
66	99.50	100	100	0	-0.50
67	92.67	99	95	4	-2.33
68	96.67	99	98	1	-1.33
69	99.00	92	94	-2	5.00
70	98.67	99	90	9	8.67
71	97.33	99	95	4	2.33
72	97.00	90	94	-4	3.00
73	97.67	95	85	10	12.67
74	97.67	99	100	-1	-2.33
75	98.33	96	98	-2	0.33
76	99.67	98	100	-2	-0.33
77	99.33	100	100	0	-0.67
78	99.00	99	99	0	0.00
79	98.00	98	97	1	1.00
80	98.00	95	98	-3	0.00
81	99.00	99	99	0	0.00
82	96.33	97	98	-1	-1.67
83	98.33	100	98	2	0.33
84	99.33	99	98	1	1.33
85	99.67	99	100	-1	-0.33

86	99.00	99	99	0	0.00
87	98.33	100	102	-2	-3.67
88	99.00	100	99	1	0.00
89	98.67	98	95	3	3.67
90	98.33	98	98	0	0.33
91	98.67	99	99	0	-0.33
92	97.00	98	98	0	-1.00
93	99.00	99	99	0	0.00
94	98.67	98	99	-1	-0.33
95	99.33	100	98	2	1.33
96	97.67	97	98	-1	-0.33
97	99.67	100	100	0	-0.33
98	98.33	98	98	0	0.33
99	102.00	99	98	1	4.00
100	99.00	95	97	-2	2.00
101	98.00	98	98	0	0.00
102	99.00	100	98	2	1.00
103	98.33	98	98	0	0.33
104	98.67	98	98	0	0.67
105	98.67	98	98	0	0.67
106	98.67	98	97	1	1.67
107	98.50	98	99	-1	-0.50
108	94.00	100	98	2	-4.00
109	102.00	100	98	2	4.00
110	98.67	100	89	11	9.67
111	98.33	100	98	2	0.33
112	98.00	100	98	2	0.00
113	98.33	99	95	4	3.33
114	99.00	98	98	0	1.00
115	98.67	98	98	0	0.67
116	98.67	99	98	1	0.67
117	98.33	97	98	-1	0.33
118	99.33	98	100	-2	-0.67
119	98.67	98	99	-1	-0.33
120	98.50	100	86	14	12.50
121	98.00	98	97	1	1.00
122	98.00	99	98	1	0.00
123	99.33	98	97	1	2.33
124	98.00	99	98	1	0.00
125	99.00	99	98	1	1.00
126	98.00	100	98	2	0.00
127	97.33	97	97	0	0.33
128	98.33	98	98	0	0.33
129	99.00	99	100	-1	-1.00
130	98.00	99	98	1	0.00

131	98.00	100	97	3	1.00
132	94.33	98	97	1	-2.67
133	94.67	98	100	-2	-5.33
134	98.67	98	99	-1	-0.33
135	98.00	99	99	0	-1.00
136	97.67	98	100	-2	-2.33
137	98.67	99	99	0	-0.33
138	98.67	100	99	1	-0.33
139	97.67	99	99	0	-1.33
140	98.33	98	99	-1	-0.67
141	98.33	99	98	1	0.33
142	98.33	99	99	0	-0.67
143	99.33	99	99	0	0.33
144	98.33	99	99	0	-0.67
145	99.67	90	99	-9	0.67
146	98.67	99	98	1	0.67
147	98.33	98	100	-2	-1.67
148	98.67	99	98	1	0.67
149	99.00	99	99	0	0.00
150	99.67	99	100	-1	-0.33
151	99.00	98	99	-1	0.00
152	98.33	98	98	0	0.33
153	99.67	99	98	1	1.67
154	99.00	99	98	1	1.00
155	98.50	99	99	0	-0.50
156	98.00	97	98	-1	0.00
157	98.67	98	98	0	0.67
158	99.00	99	99	0	0.00
159	99.00	99	98	1	1.00
160	98.00	99	98	1	0.00
161	98.00	100	98	2	0.00
162	98.67	98	99	-1	-0.33
163	94.00	99	98	1	-4.00
164	99.00	100	98	2	1.00
165	98.67	99	98	1	0.67
166	98.33	98	98	0	0.33
167	97.33	99	100	-1	-2.67
168	99.33	99	99	0	0.33
169	98.67	98	99	-1	-0.33
170	99.33	93	98	-5	1.33
171	98.00	100	99	1	-1.00
172	97.67	99	98	1	-0.33
173	98.67	98	92	6	6.67
174	98.67	100	99	1	-0.33
175	97.67	99	98	1	-0.33

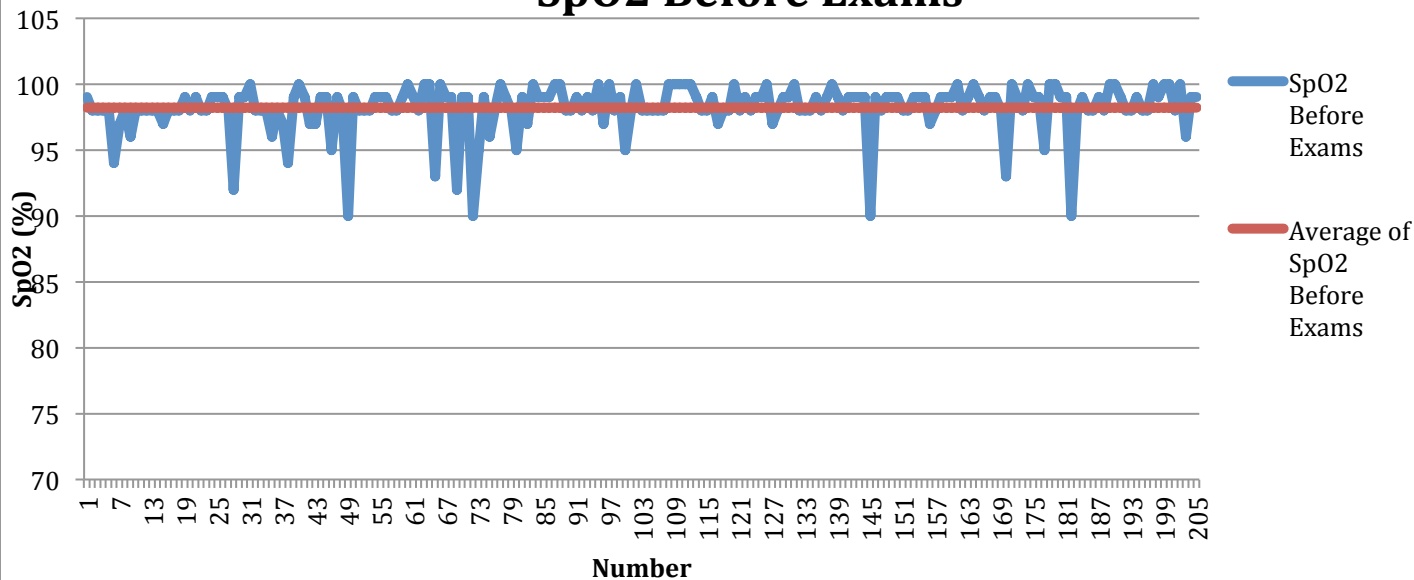
176	98.33	99	99	0	-0.67
177	98.33	95	98	-3	0.33
178	98.33	100	99	1	-0.67
179	99.33	100	99	1	0.33
180	98.33	99	98	1	0.33
181	99.67	99	99	0	0.67
182	98.67	90	90	0	8.67
183	98.33	98	98	0	0.33
184	98.67	99	99	0	-0.33
185	99.00	98	99	-1	0.00
186	99.67	98	99	-1	0.67
187	99.00	99	99	0	0.00
188	98.33	98	98	0	0.33
189	99.67	100	99	1	0.67
190	99.00	100	99	1	0.00
191	98.50	99	99	0	-0.50
192	98.00	98	98	0	0.00
193	98.67	98	98	0	0.67
194	99.00	99	99	0	0.00
195	99.00	98	98	0	1.00
196	98.00	98	98	0	0.00
197	98.00	100	101	-1	-3.00
198	98.67	99	98	1	0.67
199	94.00	100	99	1	-5.00
200	99.00	100	99	1	0.00
201	98.67	98	98	0	0.67
202	98.33	100	98	2	0.33
203	97.33	96	99	-3	-1.67
204	99.33	99	98	1	1.33
205	98.67	99	99	0	-0.33
<b>Average</b>	<b>98.36</b>	<b>98.22</b>	<b>97.87</b>	<b>0.35</b>	<b>0.48</b>
<b>S.Dev</b>	<b>1.13</b>	<b>1.82</b>	<b>2.69</b>	<b>2.96</b>	<b>2.86</b>

## Every Control SpO2 and the Average of Every Control SpO2

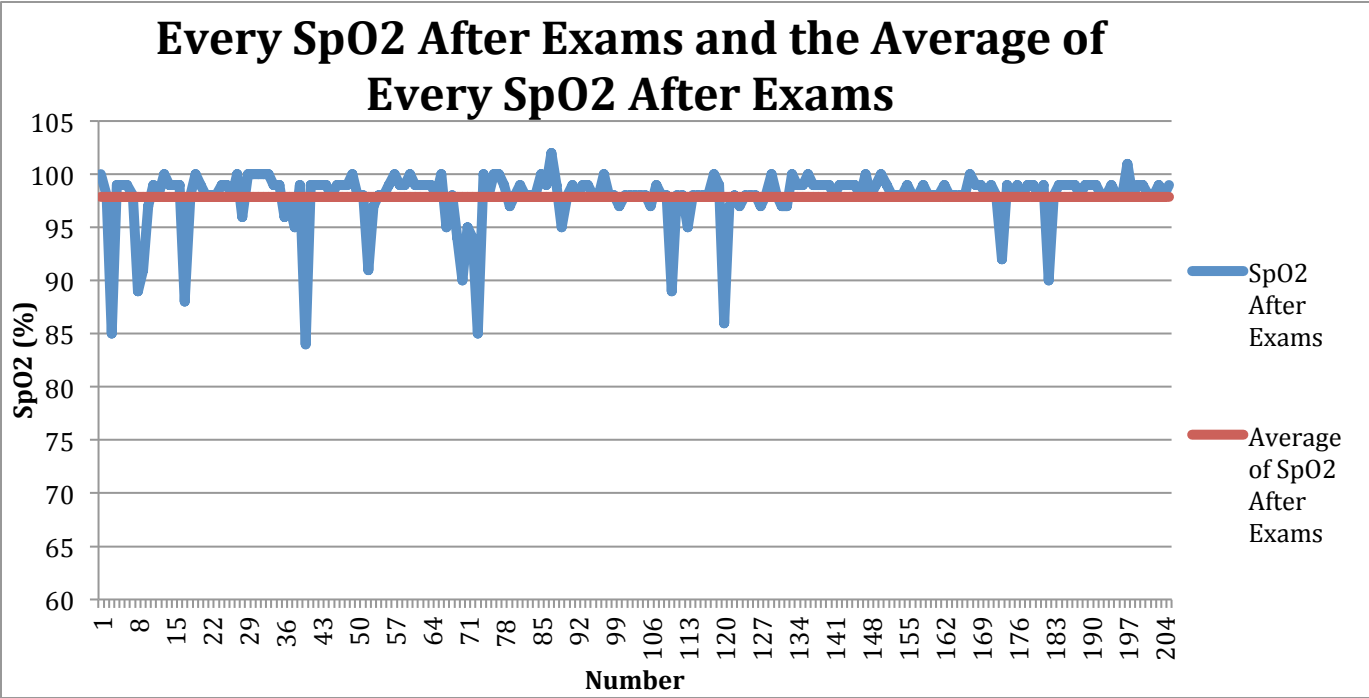


This graph shows every control SpO2 collected and is being compared to the average of all the control SpO2 readings that were collected. This will show how each reading varies from the average.

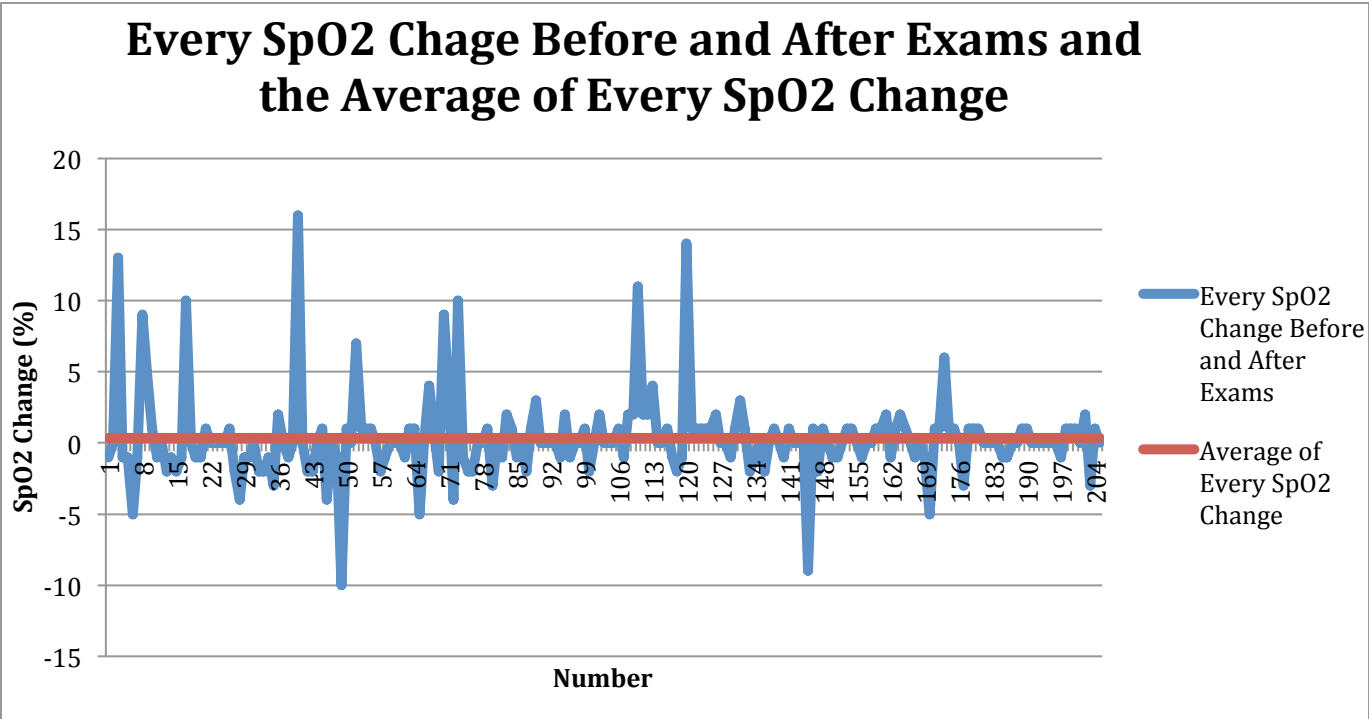
## Every SpO2 Before Exams and the Average of Every SpO2 Before Exams



This graph shows every SpO2 reading collected before exams and is being compared to the average of all the SpO2 readings taken before exams. This will show how each reading is different from the overall average.

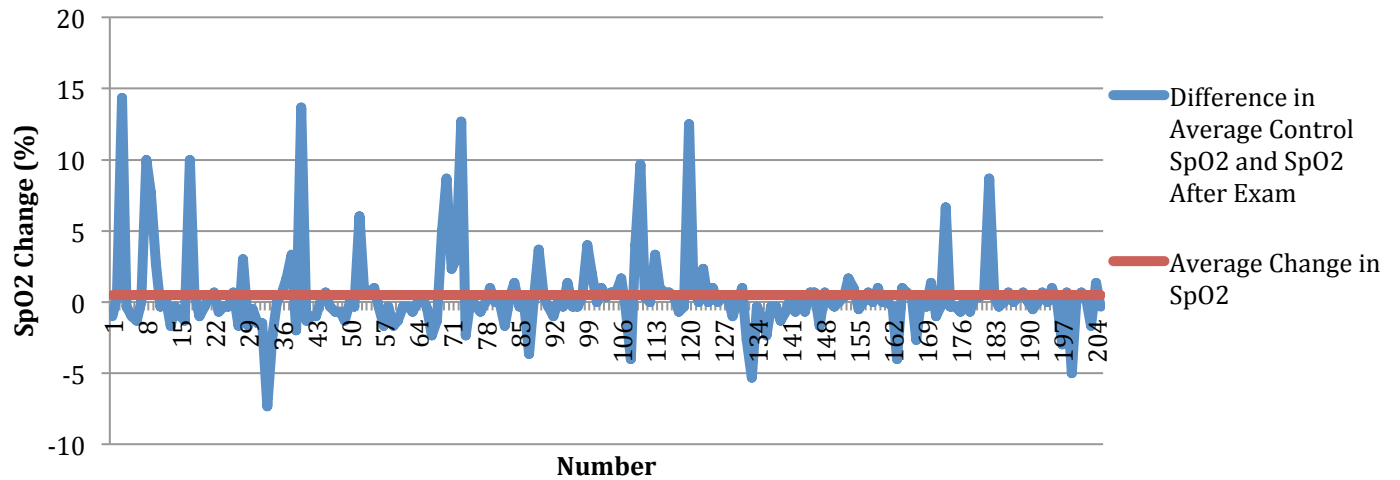


This graph shows every SpO2 readings after exams and is being compared to the average of all the SpO2 readings collected after the exams. This will shows how the readings vary from the overall average.



This graph shows every SpO2 change between before and after exams. It is being compared to the average change among all the differences between before and after the exams.

## Every SpO2 Change After Exams and Average Control SpO2 and the Average Change Between After Exams and Average Control SpO2



This graph shows every SpO2 change between after exams and the average control SpO2. It is being compared with the average change among all the readings. This graph will show whether or not SpO2 stayed normal through out exams and did not experience drastic changes.





