Heart rates from Three Different Exercises

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Topical Agenda

- Abstract: Alynne Wong

- Introduction: Alynne Wong

- Methods: Jason Aguilar

- Results: Jason Aguilar & Erik Ho

- Discussion: Martin Perez

- Conclusion: Martin Perez

Table of Contents

- **Abstract**
- Introduction
- Methods
- Results
- Discussion
- Conclusion

Abstract

- Used a Single Factor Anova to get results

- Did Post-Hoc to either reject or accept

- Then analyzed using Regression analysis

Introduction

- Objective: to compare 30 people's heartrates doing jumping jacks, sit-ups, and push-ups.

Introduction

- Heart rate is the rate that your heart pumps per minute
- The heart must pump blood at a rate that ensures the body receives enough oxygen to have enough energy
- Exercising: the heart requires 3 to 4 times the cardiac input
- 64% to 76% would be the goal heart rate for moderate exercises
- Max heart rate= 220-age

Figure #1 – Schematic of a heart rate when under intense exercises

Methods

- Conducted 3 different exercises on 30 individuals, with 10 being assigned to one exercise each.

- Used an apple watch to measure heart beats per minute after their assigned exercise

- Used excel to store the data

Figure #2 – Apple Watch Schematic

7

Methods (Continued)

- Plugged data into Single Factor Anova to get results

- Did Post-Hoc to either reject or accept hypothesis

- Then analyzed using Regression analysis

- An ANOM was used to see the similarities and differences within the groups

- A normal probability plot was than constructed

- Lastly a Box and Whiskers plot was used to see variation between all 3 exercises
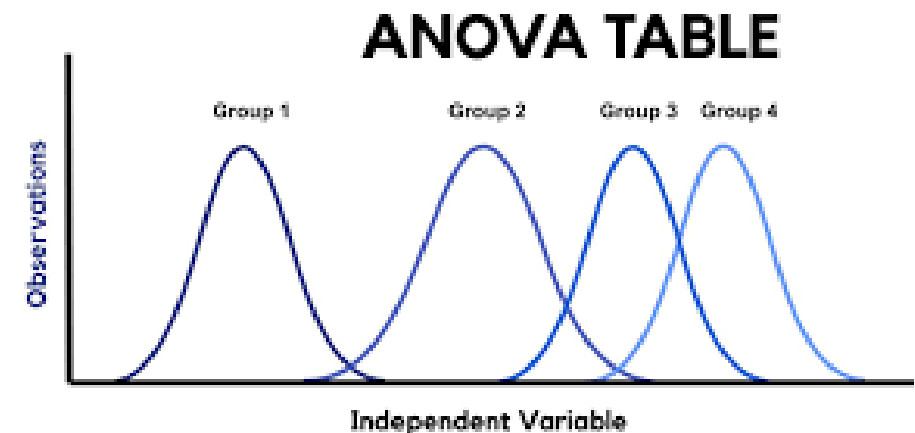
ANOVA TABLE

Figure #3 - ANOVA example diagram

8

Results

Heart Rate (BPM)					
Person	Jumping jacks (20)	Person	Sit Ups(20)	Person	Push Ups(20)
1	132	11	115	21	133
2	136	12	126	22	130
3	137	13	135	23	136
4	131	14	128	24	132
5	133	15	110	25	135
6	136	16	119	26	136
7	132	17	122	27	133
8	135	18	127	28	128
9	128	19	114	29	131
10	133	20	129	30	134
Max	137		135		136
mean	133.3		122.5		132.8
stdev	2.750757471		7.877534865		2.616188916

Table #1 – Heart Rate Data of all three exercises from 30 people

Null Hypothesis: For every amount of time no matter the type of exercise, your heart-beat will be beating the same

Alternative Hypothesis: Depending on the exercise, there will be a difference in heart rate for all three exercise

Results

ANOVA

ANOVA Results	
Grand mean	129.533333
n	30
c	3
SSA	575.62963
SSW	623.777778
SST	1199.40741
MSA	115.125926
MSW	29.7037037
F-statistic	3.87581047
F-crit	2.68478073
p-value	0.01205759
Confidence Level	95%

Table #2 – ANOVA summary results

- Null Hypothesis is rejected
  - F-statistic > F-critical
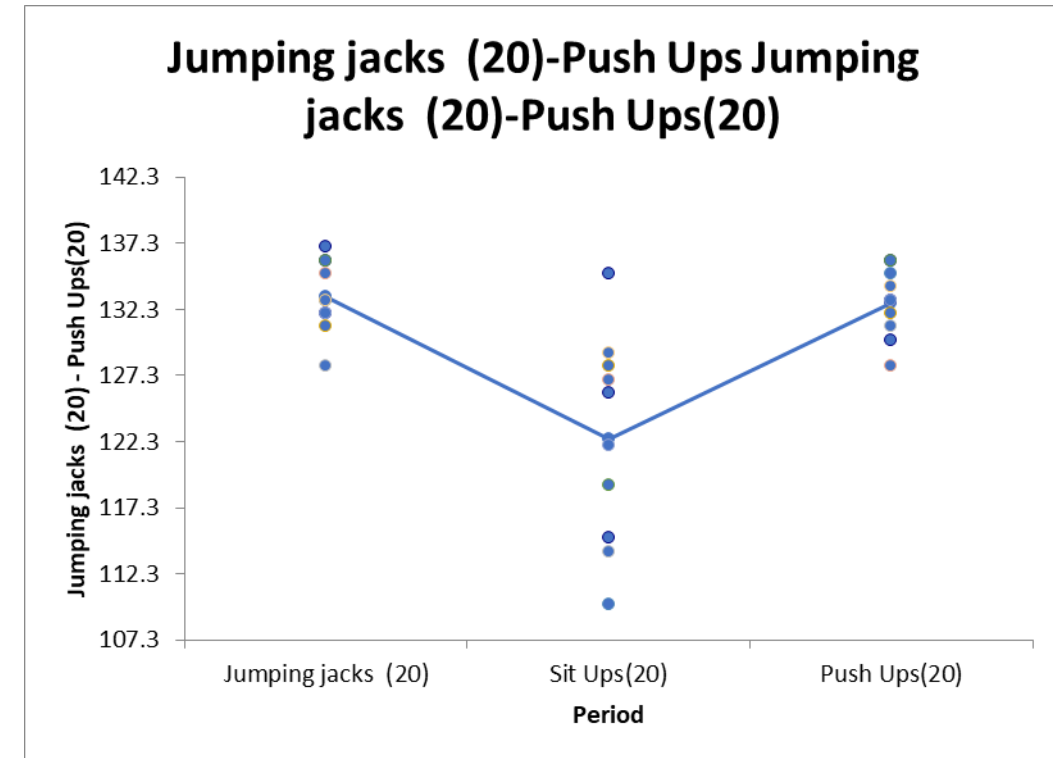 - Calculated p-value < given p-value
    - 0.0121 < 0.05

Figure #4 - ANOVA Graphical representation

Results

Post Hoc

NOTE: Because the Null Hypothesis is rejected, the Post Hoc testing can be conducted

q_u =	3.51
critical range =	11.04465

		Differences
1	$|\bar{X}_{10} - \bar{X}_{20}|$	10.80
2	$|\bar{X}_{10} - \bar{X}_{30}|$	0.50
3	$|\bar{X}_{20} - \bar{X}_{30}|$	10.30

		Decision (Reject or Accept)
1	$|\bar{X}_{10} - \bar{X}_{20}|$	Significantly different
2	$|\bar{X}_{10} - \bar{X}_{30}|$	Not Significantly different
3	$|\bar{X}_{20} - \bar{X}_{30}|$	Significantly different

Table #3 – Collective data of Post Hoc testing

If difference < critical range, then decision is NOT significantly different.

If difference > critical range, then decision is significantly different.

Results

Regression Analysis

| Exercise	Jumping Jacks	Sit Ups	Push Ups
Correlation Coefficient	0.340204184	0.016305326	0.140275773
Coefficient of Determination	0.115738887	0.000265864	0.019677292
a	-0.309090909	-0.042424242	-0.121212121
b	135	123.1575758	135.8909091
Least Square fit equation	y = -0.30909x + 135	y = -0.0424x + 123.157	y = -0.12121x + 135.8909
Standard Error	2.743587565	8.354276713	2.747450609
x*	20	20	20
ax*+b	128.82	122.309	133.4667
t	2.306	2.306	2.306
Margin of Error	87.097	85.92	91.2963
Prediction Interval	[41.723 215.917]	[36.389 208.229]	[42.1704 224.763]

Table #4 – Regression Analysis Summary Data

Results

Correlation
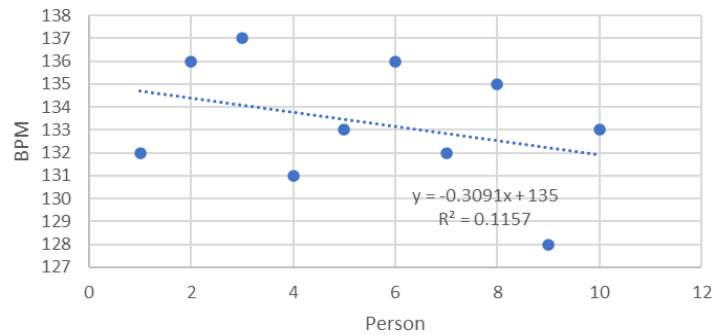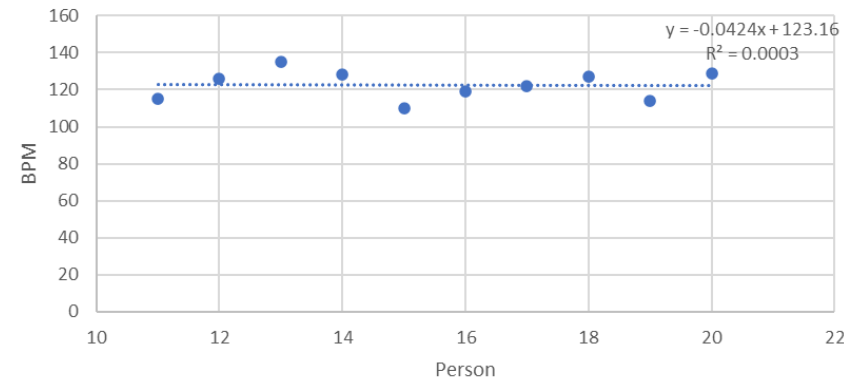
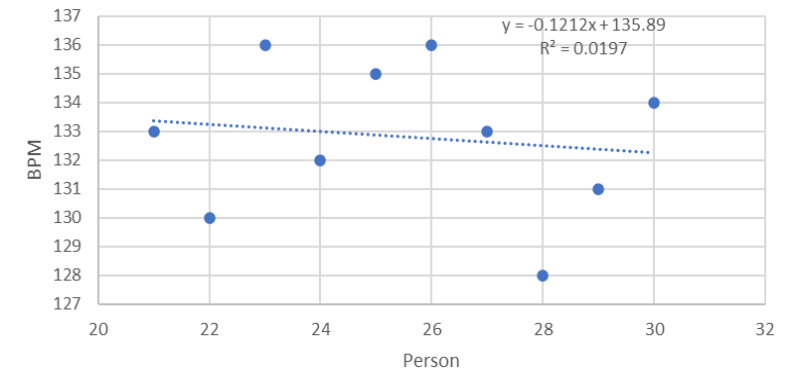Figure #5 - Regression Analysis plots of 3 exercises

- Regression for all three exercises are negatively decreasing

Results

ANOM

ANOM	
Grand Mean	129.5333333
α	0.05
ν	27
n	3
N	30
h(α;n,ν)	2.49
Mean square error	29.7037037
Upper Dot #1	133.3
Upper Dot #2	132.8
Lower Dot	122.5
LDL	126.2223001
UDL	132.8443666

Table #5 – ANOM test Summary

- Jumping Jacks heart rate is "significantly worse"
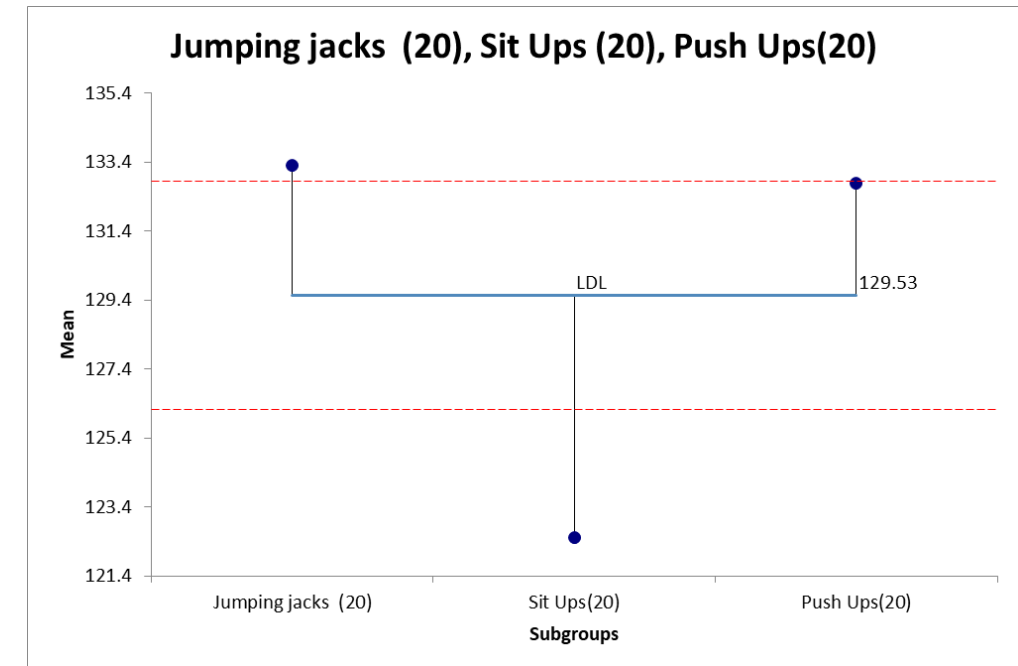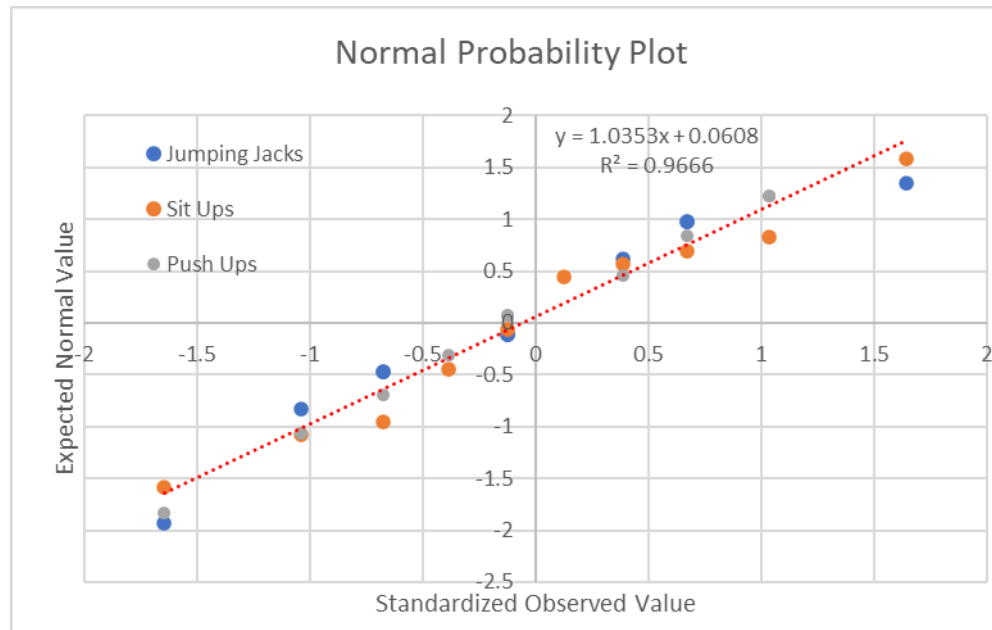- Sit Ups mean heart rate is "significantly better"

Figure #6 – ANOM Graphical representation

Results

Normality

Figure #7 – Normal Probability Plot of all 3 Exercises

- Probability plot is normally distributed
- Minor deviations

Results

Normality

- Jumping Jack distribution is skewed to the left

- Sit Ups distribution skewed to the right
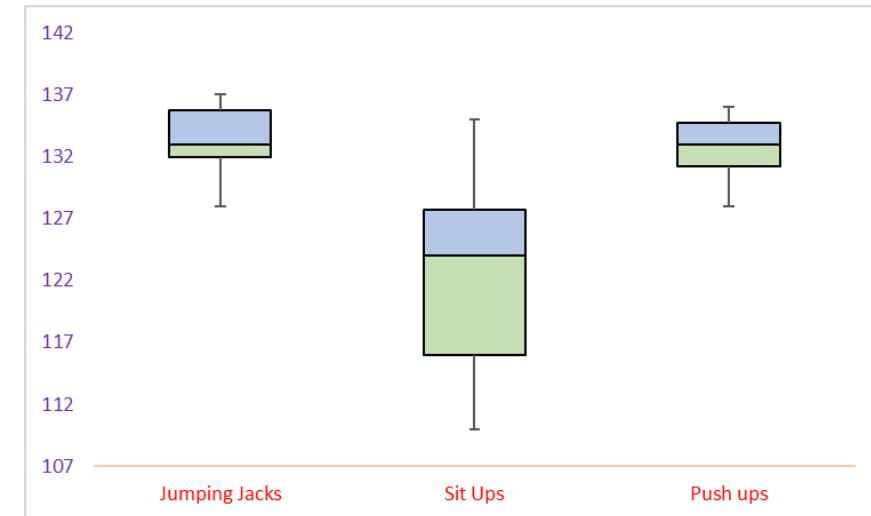
- Push Ups distribution is symmetrical

Figure #8 – Box and Whisker's Plot of the 3 Exercises

Discussion

- Null hypothesis was rejected

- Normal Distribution

- Regression analysis for all three exercise was negatively decreasing

- "Heart rate increases are dependent on the intensity of the exercise" [2]

- Additional testing was conducted but with younger subjects

Discussion

Limitations

- Age groups
- Body build
- Weight
- Height

Recommendations

- Different age groups
- Add more variety of body structures

Conclusion

- The Null hypothesis was rejected

- Figured out what distribution this experiment was

- Found and compared the regression analysis of each exercise

References

- *(1) https://theheartfoundation.org/2018/11/02/your-heart-rate/*

- *(2)* https://9to5mac.com/2022/12/23/apple-watch-heart-rate-history/

- (3) https://estamatica.net/anova-table-with-spss/