Happiness and its Determinants

Group-12

Shrey Arora

Maheedhar Kolli

STAT 571B

Introduction

Happiness is a subjective emotion that brings about positive feelings and a sense of contentment and fulfillment. It is closely linked with mental, physical, and spiritual health. Research has shown that people who are happier tend to have better mental health, including lower rates of depression and anxiety, as well as better physical health, with reduced risk of chronic diseases such as heart disease and diabetes. Moreover, spiritual well-being has also been associated with increased happiness, with individuals who report higher levels of spiritual well-being reporting greater levels of overall happiness and life satisfaction. Thus, cultivating happiness through various means such as self-care, meaningful relationships, and spiritual practices can have a positive impact on one's overall well-being.

The objective of this research is to study how physical activities like playing sports or running, cognitive activities like reading a book or coursework, and recreational or spiritual activities like meditation or writing and composing music can affect your happiness and productivity level as measured through self assessed scores.

There are total six activities that we want to track

1. Meditation
2. Running
3. Workout/Sports
4. Journal
5. Reading
6. Course work

Experimental Design

Below given table shows a snapshot of the data entries for days for the above mentioned activities. Y is the self assessed output score, recorded out of 10. Yellow colored columns account for physical activities

Date	Run	Meditate	Course work	Write/Music	Football/Work out	Read	Y
9/4/2022	1	0	1	1	1	0	8
9/5/2022	1	1	0	0	1	1	6
9/6/2022	1	1	0	1	0	1	5
9/7/2022	1	1	0	1	1	0	8
9/8/2022	1	1	1	0	0	1	7
9/9/2022	1	1	1	0	1	0	7
9/10/2022	1	1	1	1	0	0	7

From this data we created three levels (0,1,2) for Physical, Cognitive and Spiritual Activities as shown in below tables. Total 27 combinations were created and replicated twice accounting for 54 data points. This makes our design 3 factorial 3 level experiment design.

Date	Y	Physical	Cognitive	Spiritual
9/4/2022	8	2	1	1
9/5/2022	6	2	1	1
9/6/2022	5	1	1	2
9/7/2022	8	2	0	2
9/8/2022	7	1	2	1
9/9/2022	7	2	1	1
9/10/2022	7	1	1	2
9/11/2022	6	1	2	2
9/12/2022	7	2	2	1
9/13/2022	2	2	1	2

9/14/2022	**5**	2	2	1
9/15/2022	**3**	1	2	2
9/16/2022	**6**	2	1	2

The 3^3 design

The model and treatment runs for a 3 factor, 3-level design

This is a design that consists of three factors, each at three levels.

		Factor A		
Factor B	**Factor C**	**0**	**1**	**2**
0	0	000	100	200
0	1	001	101	201
0	2	002	102	202
1	0	010	110	210
1	1	011	111	211
1	2	012	112	212
2	0	020	120	220
2	1	021	121	221
2	2	022	122	222

It can be expressed as a 3 x 3 x 3 = 3^3 design.

The model for such an experiment is

Yijk=μ+Ai+Bj+ABij+Ck+ACik+BCjk+ABCijk+ϵijk

Experiment design matrix

Physical	Cognitive	Spiritual		
		0	1	2
0	0	0,0	7,5	7,7
	1	7,5	6,2	6,5
	2	6,6	6,3	7,7
1	0	6,3	7,6	5,4
	1	9,7	6,4	7,6
	2	6,6	7,6	6,5
2	0	7,8	8,8	8,9
	1	6,7	8,7	6,6
	2	10,10	7,6	10,9

SAS CODE

```
data ip;
Input P C S Y;
datalines;
2 1 1 8
2 1 1 6
1 1 2 6
2 0 2 8
1 2 1 7
2 1 1 7
1 1 2 7
1 2 2 9
2 2 1 8
2 1 2 9
2 2 1 7
1 2 2 7
2 1 2 6
2 2 2 10
1 2 1 6
2 2 0 8
2 1 1 6
```

1 1 2 7

0 2 2 7

1 2 1 7

1 1 2 7

1 2 1 6

1 1 1 5

1 0 2 5

2 0 1 6

1 1 1 4

1 1 1 5

2 1 0 6

1 2 0 6

2 0 1 7

1 1 1 5

2 1 0 6

0 1 2 6

1 1 0 4

0 1 1 2

0 1 1 4

1 0 1 5

0 0 2 6

0 1 1 5

1 1 0 4

2 0 0 5

1	0	1	4
1	1	0	4
1	0	1	4
1	1	1	6
1	2	0	7
0	2	1	6
1	1	1	4
1	1	1	4
0	1	2	6
1	0	2	7
0	2	1	7
1	1	1	4
0	2	0	5
1	0	1	6
0	1	1	6
1	1	0	7
1	0	0	4
0	0	1	4
0	1	0	6
0	0	1	5
1	0	0	2
0	1	0	3
0	0	0	0
0	0	0	0

```
2 2 2 10
;
proc glm data=ip;
class P C S;
model Y=P C S P*C P*S C*S P*C*S;
output out=out r=res p=pred;
means P C S P*C P*S C*S P*C*S;
run;
PROC univariate data=out normal;
var res;
qqplot res /normal(MU=0 SIGMA=EST);
run;
proc sgplot data=out;
scatter x=pred y=res;
refline 0;
run;
proc glm data=ip;
class P C S;
model Y=P C S P*C P*S C*S P*C*S;
run;
```

Results

ANOVA TABLE

Source	DF	Type I SS	Mean Square	F Value	Pr > F
P	2.0	62.8	31.4	27.8	<.0001
C	2.0	56.0	28.0	24.7	<.0001
S	2.0	51.9	25.9	22.9	<.0001
P*C	4.0	3.1	0.8	0.7	0.61
P*S	4.0	4.2	1.0	0.9	0.46
C*S	4.0	13.7	3.4	3.0	0.03
P*C*S	8.0	8.2	1.0	0.9	0.52

Based on the analysis, all three main factors, P, C, and S, significantly influence the outcome variable (p < .0001 for all).

Additionally, the interaction between P and C does not have a significant effect (p = 0.61), indicating that the combined influence of Physical and Cognitive Activity is not statistically different from what would be expected from their individual effects.

Similarly, the interaction between P and S (p = 0.46) and the interaction between C and S (p = 0.03) do not have significant effects, suggesting that the combined influences of Physical and Spiritual Activity and Cognitive and Spiritual Activity, respectively, do not deviate significantly from the effects of their individual components.

In conclusion, Physical, Cognitive, and Spiritual Activities individually have a significant influence on the outcome variable, but their combined effects and interactions do not reach statistical significance. This suggests that each activity type independently contributes to the outcome, without any strong synergistic or interactive effects when considered together.


Distribution of Y

Distribution of Y
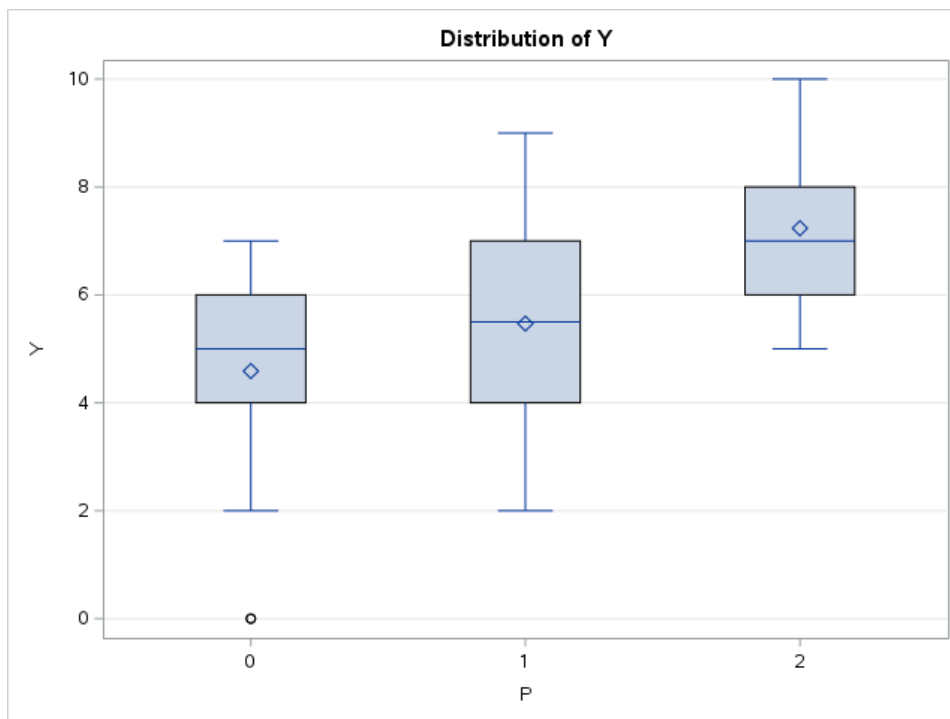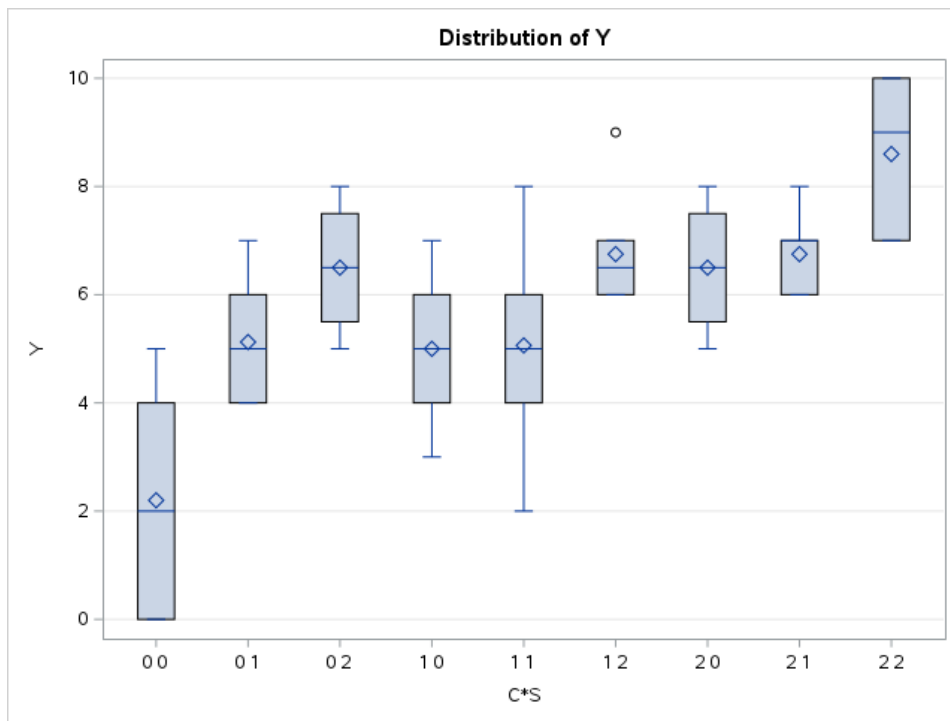
From above plots we can see that the response variable gives the better output when the tasks reach maximum level of 2

Diagnostics

Tests for Normality				
Test	Statistic		p Value	
Shapiro-Wilk	W	0.973172	Pr < W	0.1626
Kolmogorov-Smirnov	D	0.106814	Pr > D	0.0613

Cramer-von Mises	W-Sq	0.143946	Pr > W-Sq	0.0284
Anderson-Darling	A-Sq	0.815255	Pr > A-Sq	0

Q-Q Plot for res
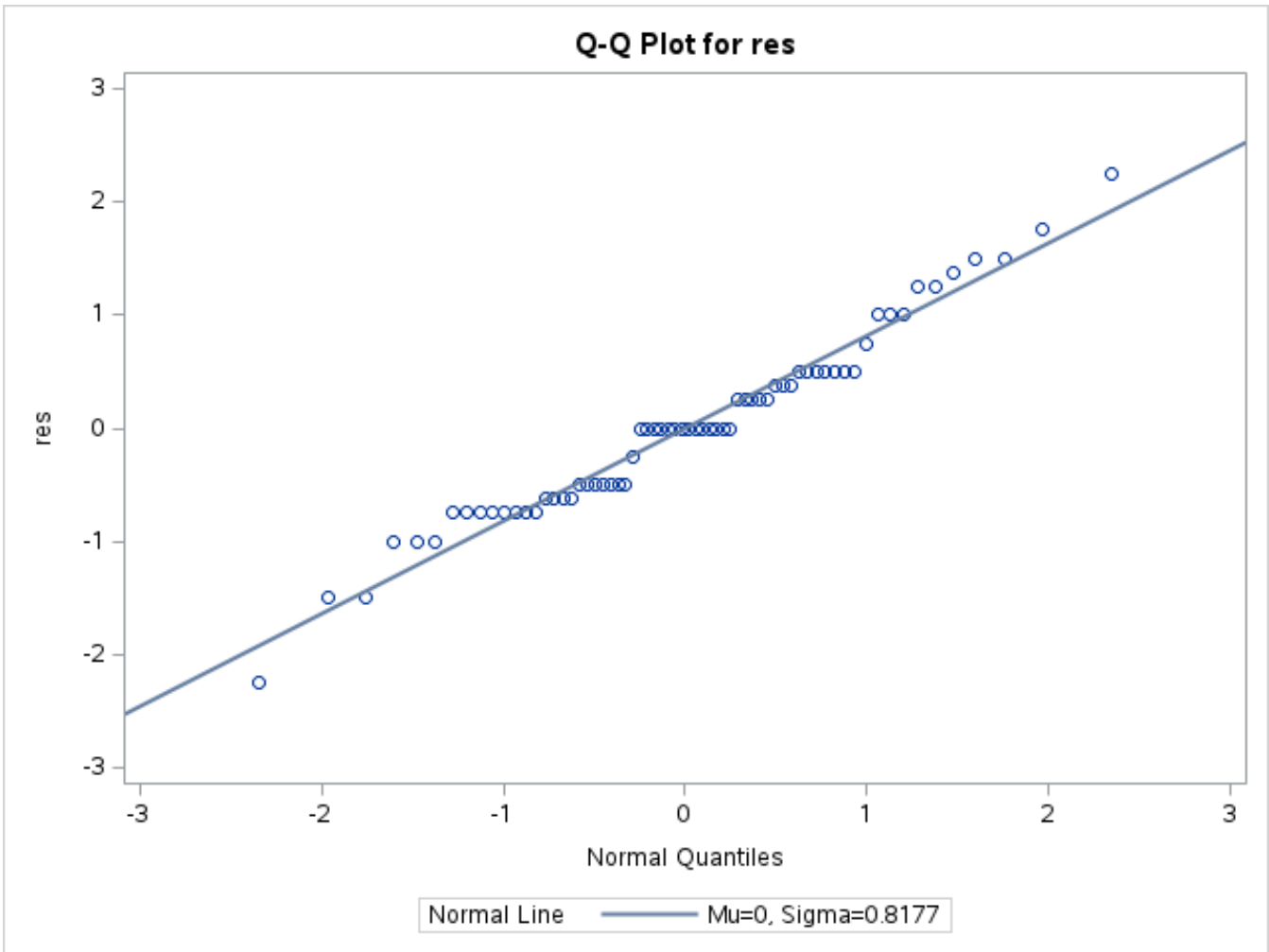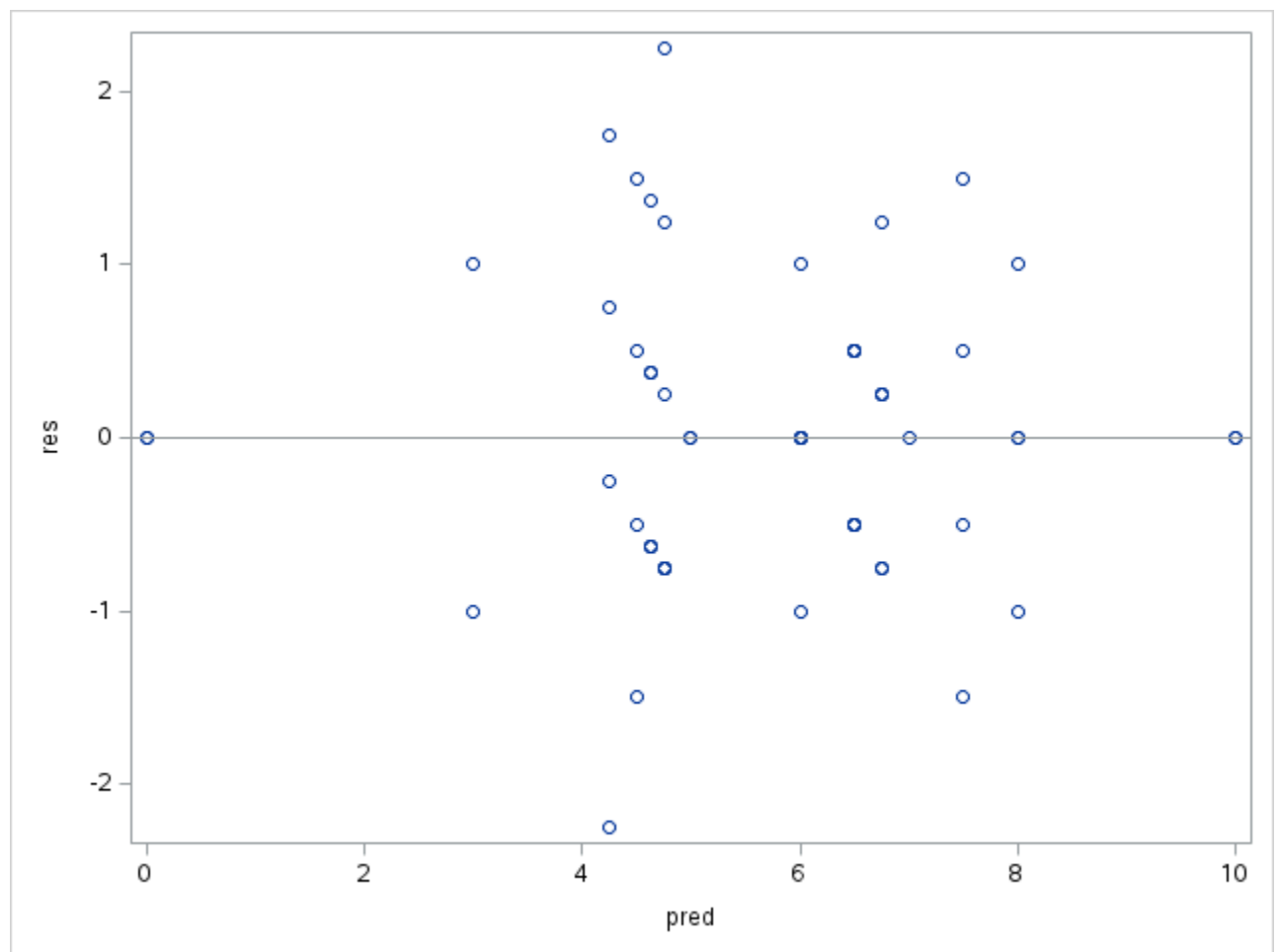
Future Scopes

- time series analysis (ARIMA etc.)

- Add more replicates to improve precision

- Y (response measure) - Add more components to the response variable like food habits, calorie intake etc