

# Summary

Screen time usage is becoming an increasingly significant part of modern lifestyles.

With the rise of smartphones, tablets, and computers in daily routines, we aim to understand how much time university students spend on electronic devices, as well as how this relates to their health, habits, and overall digital well-being. We also explore which days tend to have the highest screen time and which types of applications are used the most.

## Group 6

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# Data Collection

We collected the data with a survey using Google Forms. Our target is people in different age groups. The survey is mostly in Thai and was accepting the result from April 12, 2025 until April 17, 2025, and 57 people responded to the survey.

The survey questions are :

1. What is your age?
2. What is your gender?
3. What is your weight (kg.) ?
4. What is your heart rate while answering the survey?
5. What is your approximate average sleeping duration (Hr.min) ?
6. How much screen duration did you spend on Sunday (Hr.min) ?
7. How much screen duration did you spend on Monday (Hr.min) ?
8. How much screen duration did you spend on Tuesday (Hr.min) ?
9. How much screen duration did you spend on Wednesday (Hr.min) ?
10. How much screen duration did you spend on Thursday (Hr.min) ?
11. How much screen duration did you spend on Friday (Hr.min) ?
12. How much screen duration did you spend on Saturday (Hr.min) ?
13. What is your most used application type?
14. How much notification did you receive on Sunday?
15. How much notification did you receive on Monday?
16. How much notification did you receive on Tuesday?
17. How much notification did you receive on Wednesday?
18. How much notification did you receive on Thursday?
19. How much notification did you receive on Friday?
20. How much notification did you receive on Saturday?
21. What is the current condition of your left eye?
  - 21.1 How is your eyesight (normal, near-sighted, far-sighted or Myopic Presbyopia) ?
    - 21.1.1 If you are near-sighted, how much?
    - 21.1.2 If you are far-sighted, how much?
    - 21.1.3 If you have compound vision, how much?
  - 21.2 Other abnormalities?
22. What is the current condition of your right eye (normal, near-sighted, far-sighted or compound vision) ?
  - 22.1 How is your eyesight (normal, near-sighted, far-sighted or Myopic Presbyopia) ?
    - 22.1.1 If you are near-sighted, how much?
    - 22.1.2 If you are far-sighted, how much?
    - 22.1.3 If you have compound vision, how much?
  - 22.2 Other abnormalities?

After we collected the data, we cleaned up the data. We found that there was data that

had the same answers in every question(both surveys have the same answer and the answers came from the example provided in the form) except gender and age, so we did not use their answers. Another problem is the respondents did not follow the instructions that we provided, so the answers might not be accurate.

We found that most of the respondents were Male with 52.2%, followed by female with 47.8%. Majority of the respondents are 18-19 years old (45.65%), followed by older ages.

If we grouped the data by type of application used the most per day, 58.7% of the respondents spent the most time on entertainment application, followed by social media with 34.8%, education with 4.3% and information reading with 2.2%.

If we grouped the data by day of week that the respondents spend their time on the screen the most, 23.9% of the respondents spent time on their screen on Sunday the most, followed by Thursday Tuesday, Wednesday Friday Saturday and Monday with 15.3%, 13.0% and 6.5% of the respondents respectively.

If we grouped the data by day of week that the respondents spend their time on the screen the least, 28.3% of the respondents spent time on their screen on Monday the least, followed by Thursday Saturday, Wednesday Sunday, Tuesday and Friday with 19.6%, 10.9%, 8.7% and 2.2% of the respondents respectively.

# Methodology

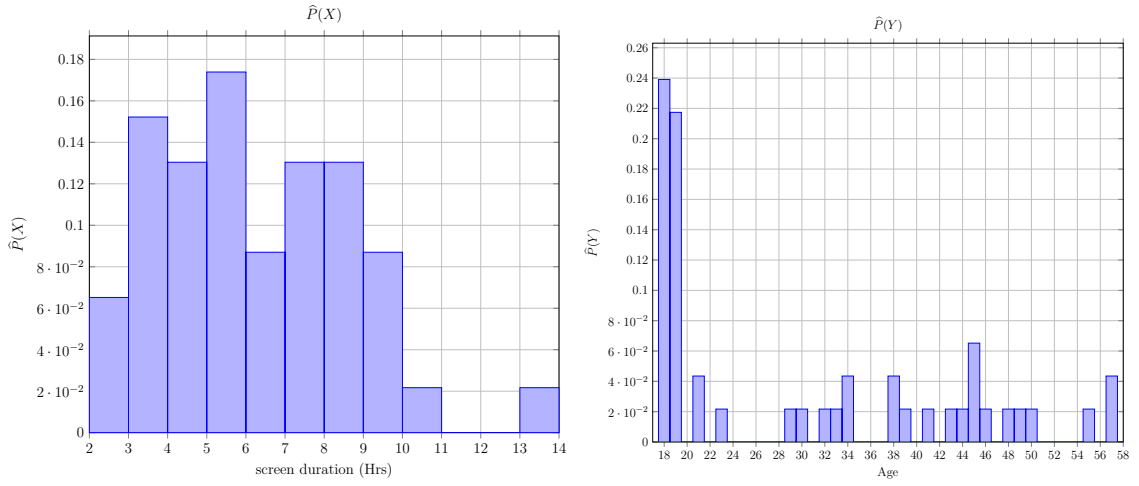
## Probability

### Screen time vs Age

$y \backslash x$	2	3	4	5	6	7	8	9	10	11	12	13	$\hat{P}(Y)$	$y \cdot \hat{P}(Y)$
	3	4	5	6	7	8	9	10	11	12	13	14		
18	0.0217	0.0652	0	0.0217	0	0.0217	0.0435	0.0435	0.0217	0	0	0	0.2391	4.3043
19	0	0	0.0217	0.0435	0.0435	0.0217	0.0217	0.0435	0	0	0	0.0217	0.2174	4.1304
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0.0217	0.0217	0	0	0	0	0	0.0435	0.913
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0.0217	0	0	0	0	0	0	0	0	0	0	0	0.0217	0.5
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0.0217	0	0	0	0	0	0	0	0	0	0	0.0217	0.6304
30	0	0	0	0	0.0217	0	0	0	0	0	0	0	0.0217	0.6522
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0.0217	0	0	0	0	0	0	0	0	0	0.0217	0.6957
33	0	0	0.0217	0	0	0	0	0	0	0	0	0	0.0217	0.7173913
34	0	0	0	0	0	0.0435	0	0	0	0	0	0	0.0435	1.4783
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0.0217	0.0217	0	0	0	0	0	0	0	0	0.0435	1.6522
39	0	0	0	0	0	0.0217	0	0	0	0	0	0	0.0217	0.8478
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0.0217	0	0	0	0	0	0	0	0	0.0217	0.8913
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0.0217	0	0	0	0	0	0	0	0	0	0	0.0217	0.9348
44	0	0	0	0.0217	0	0	0	0	0	0	0	0	0.0217	0.9565217
45	0	0	0	0.0217	0	0	0.0435	0	0	0	0	0	0.0652	2.9348
46	0	0.0217	0	0	0	0	0	0	0	0	0	0	0.0217	1.
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0.0217	0	0	0	0	0	0	0	0	0	0	0	0.0217	1.0435
49	0	0	0.0217	0	0	0	0	0	0	0	0	0	0.0217	1.0652
50	0	0	0	0.0217	0	0	0	0	0	0	0	0	0.0217	1.087
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0.0217	0	0	0	0	0	0	0	0.0217	1.19565217
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0.0217	0.0217	0	0	0	0	0	0	0	0	0	0.0435	2.4783
$\hat{P}(X)$	0.0652	0.1522	0.1304	0.1739	0.087	0.1304	0.1304	0.087	0.0217	0	0	0.0217	$\hat{E}(X)$	6.23913
midpoint	2.5000	3.5000	4.5000	5.5000	6.5000	7.5000	8.5000	9.5000	10.5000	11.5000	12.5000	13.5000	$\hat{E}(Y)$	30.10870
mid $\cdot \hat{P}(X)$	0.163	0.5326	0.587	0.9565217	0.5652	0.9783	1.1087	0.8261	0.2283	0	0	0.2935		

The individual probability from the table comes from dividing frequency with the number of samples.  $P[X]$  comes from summing the data for all columns.  $P[Y]$  comes from summing the data for all rows. The expected value of  $X$  ( $E[X]$ ) is 6.23913 which is calculated by summing all of  $P[X]$  and the expected value of  $Y$  ( $E[Y]$ ) is 30.10870 which is calculated by

summing all of  $P[Y]$ .



The correlation coefficient is computed by using the formula

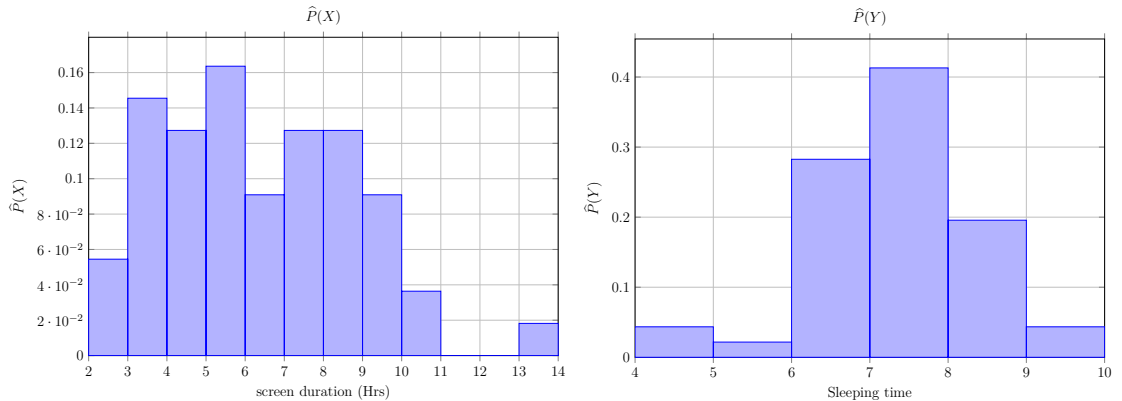
$$\hat{\rho}_{X,Y} = \frac{\hat{S}_{X,Y}}{s_X s_Y} \quad \& \quad \hat{S}_{X,Y} = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{X})(y_i - \bar{Y})$$

In this case,  $\bar{X} = 6.271$ ,  $\bar{Y} = 30.1087$ ,  $n = 46$ ,  $s_x = 2.4862$ ,  $s_y = 13.2031$ . Therefore,  $S_{X,Y} = -10.9625$  and  $r = -0.3340$ . Thus, the relation between  $X$  and  $Y$  has a weak negative relationship.

## Screen time vs Sleeping time

$\begin{matrix} \backslash x \\ y \end{matrix}$	2	3	4	5	6	7	8	9	10	11	12	13	$\hat{P}(Y)$	midpoint	mid $\cdot \hat{P}(Y)$
	3	4	5	6	7	8	9	10	11	12	13	14			
4 5	0	0	0	0	0	0	0	0.0435	0	0	0	0	0.0435	4.5	0.1957
5 6	0	0	0	0.0217	0	0	0	0	0	0	0	0	0.0217	5.5	0.1195652
6 7	0	0.0217	0.0217	0.0435	0.0652	0.0435	0.0652	0	0.0217	0	0	0	0.2826	6.5	1.837
7 8	0.0217	0.0652	0.1087	0.087	0.0217	0.0652	0.0435	0	0	0	0	0	0.413	7.5	3.0978
8 9	0.0435	0.0435	0	0.0217	0	0.0217	0.0217	0.0435	0	0	0	0	0.1956522	8.5	1.6630435
9 10	0	0.0217	0	0	0	0	0	0	0	0	0	0.0217	0.0435	9.5	0.413
$\hat{P}(X)$	0.0652	0.1522	0.1304	0.1739	0.087	0.1304	0.1304	0.087	0.0217	0	0	0.0217			
midpoint	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5		$\hat{E}(X)$	6.2391
mid $\cdot \hat{P}(X)$	0.163	0.5326	0.587	0.9565217	0.5652	0.9783	1.1087	0.8261	0.2283	0	0	0.2935		$\hat{E}(Y)$	7.3261

The individual probability from the table comes from dividing frequency with the number of samples.  $P[X]$  comes from summing the data for all columns.  $P[Y]$  comes from summing the data for all rows. The expected value of  $X$  ( $E[X]$ ) is 6.23913 which is calculated by summing all of  $P[X]$  and the expected value of  $Y$  ( $E[Y]$ ) is 7.3261 which is calculated by summing all of  $P[Y]$ .



The correlation coefficient is computed by using the formula

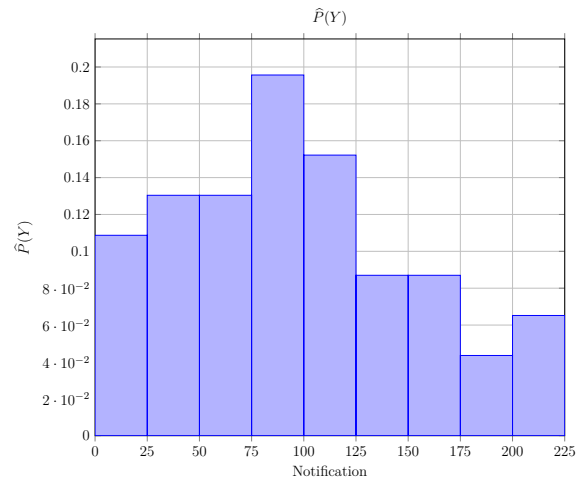
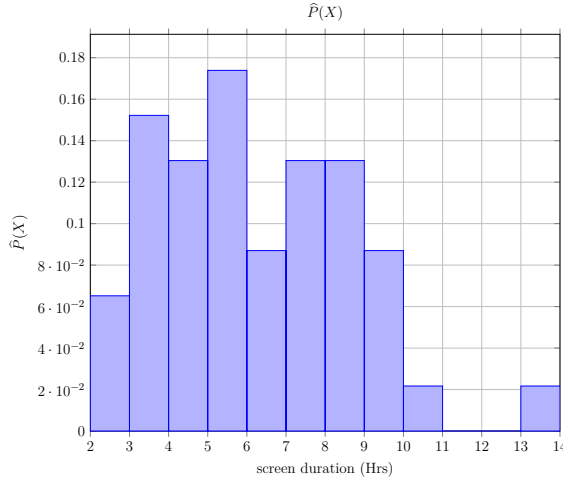
$$\hat{\rho}_{X,Y} = \frac{\hat{S}_{X,Y}}{s_X s_Y} \quad \& \quad \hat{S}_{X,Y} = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{X})(y_i - \bar{Y})$$

In this case,  $\bar{X} = 6.271, \bar{Y} = 93.7671, n = 46, s_x = 2.4862, s_y = 56.1233$ . Therefore,  $S_{X,Y} = 24.6359$  and  $r = 0.1766$ . Thus, the relation between  $X$  and  $Y$  has a weak negative relationship.

## Screen time vs Notification

$\begin{matrix} x \\ y \end{matrix}$	2	3	4	5	6	7	8	9	10	11	12	13	$\hat{P}(Y)$	midpoint	mid $\cdot \hat{P}(Y)$
	3	4	5	6	7	8	9	10	11	12	13	14			
0	25	0.0217	0	0.0217	0.0652	0	0	0	0	0	0	0	0.1087	12.5	1.3587
25	50	0	0	0.0217	0	0.0217	0.0435	0.0217	0	0	0	0.0217	0.1304	37.5	4.8913
50	75	0.0217	0.0217	0	0.0435	0	0	0.0435	0	0	0	0	0.1304	62.5	8.1522
75	100	0.0217	0.0652	0.0217	0.0435	0.0435	0	0	0	0	0	0	0.1956522	87.5	17.1195652
100	125	0	0.0435	0.0217	0.0217	0.0217	0	0.0217	0	0	0	0	0.1522	112.5	17.1196
125	150	0	0	0.0217	0	0	0	0.0217	0.0435	0	0	0	0.087	137.5	11.95652174
150	175	0	0	0	0	0	0.0652	0	0	0.0217	0	0	0.087	162.5	14.1304
175	200	0	0	0	0	0	0	0.0435	0	0	0	0	0.0435	187.5	8.1522
200	225	0	0.0217	0.0217	0	0	0	0	0.0217	0	0	0	0.0652	212.5	13.8587
$\hat{P}(X)$		0.0652	0.1522	0.1304	0.1739	0.087	0.1304	0.1304	0.087	0.0217	0	0.0217			
midpoint		2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5		$\hat{E}(Y)$	96.7391
mid $\cdot \hat{P}(X)$		0.163	0.5326	0.587	0.9565	0.5652	0.9783	1.1087	0.8261	0.2283	0	0.2935		$\hat{E}(X)$	6.2391

The individual probability from the table comes from dividing frequency with the number of samples.  $P[X]$  comes from summing the data for all columns.  $P[Y]$  comes from summing the data for all rows. The expected value of  $X$  ( $E[X]$ ) is 6.23913 which is calculated by summing all of  $P[X]$  and the expected value of  $Y$  ( $E[Y]$ ) is 81.5217 which is calculated by summing all of  $P[Y]$ .



The correlation coefficient is computed by using the formula

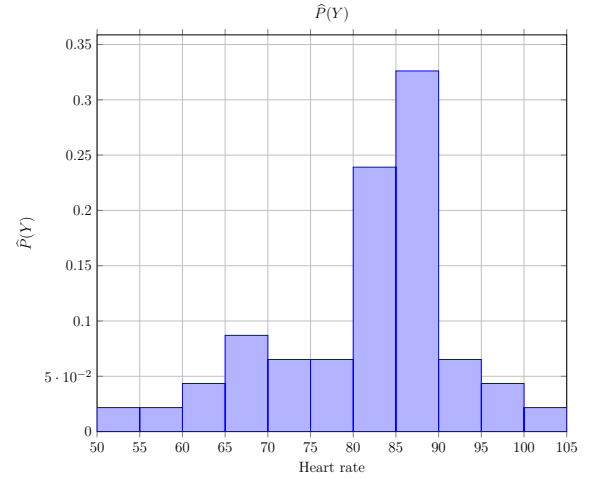
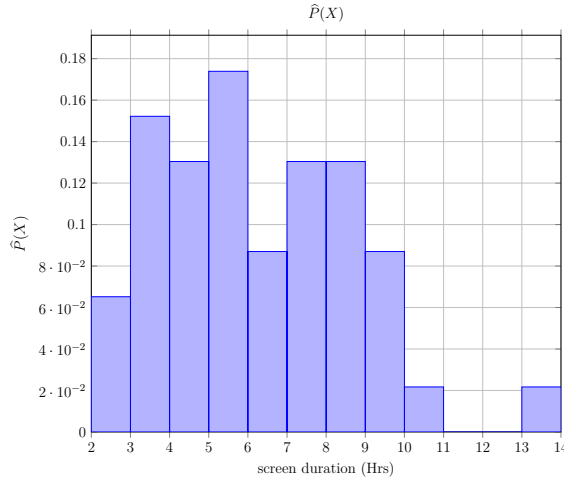
$$\hat{\rho}_{X,Y} = \frac{\hat{S}_{X,Y}}{s_X s_Y} \quad \& \quad \hat{S}_{X,Y} = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{X})(y_i - \bar{Y})$$

In this case,  $\bar{X} = 6.271, \bar{Y} = 80.7174, n = 46, s_x = 2.4862, s_y = 10.8805$ . Therefore,  $S_{X,Y} = -1.3246$  and  $r = -0.0490$ . Thus, the relation between  $X$  and  $Y$  has a weak negative relationship.

## Screen time vs Heart rate

$\begin{matrix} x \\ y \end{matrix}$														$\hat{P}(Y)$	midpoint	mid $\cdot \hat{P}(Y)$
	2	3	4	5	6	7	8	9	10	11	12	13	14			
50 55	0	0	0	0	0	0	0.0217	0	0	0	0	0	0	0.0217	52.5	1.1413
55 60	0	0.0217	0	0	0	0	0	0	0	0	0	0	0	0.0217	57.5	1.25
60 65	0	0	0	0	0	0.0435	0	0	0	0	0	0	0	0.0435	62.5	2.7174
65 70	0	0	0	0	0.0217	0.0217	0.0217	0.0217	0	0	0	0	0	0.087	67.5	5.8696
70 75	0	0.0217	0	0.0217	0	0	0	0.0217	0	0	0	0	0	0.0652	72.5	4.7283
75 80	0	0.0435	0.0217	0	0	0	0	0	0	0	0	0	0	0.0652	77.5	5.0543
80 85	0.0217	0.0435	0.0435	0.0435	0.0217	0.0217	0.0217	0.0217	0.0217	0	0	0	0	0.2391	82.5	19.72826087
85 90	0.0217	0.0217	0.0435	0.0652	0.0435	0.0435	0.0435	0.0217	0.0217	0	0	0	0	0.3261	87.5	28.5326
90 95	0	0	0	0.0435	0	0	0.0217	0	0	0	0	0	0	0.0652	92.5	6.0326
95 100	0.0217	0	0	0	0	0	0	0	0	0	0	0.0217	0	0.0435	97.5	4.2391
100 105	0	0	0.0217	0	0	0	0	0	0	0	0	0	0	0.0217	102.5	2.2283
$\hat{P}(X)$	0.0652	0.1522	0.1304	0.1739	0.087	0.1304	0.1304	0.087	0.0217	0	0	0.0217				
midpoint	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5		$\hat{E}(X)$		6.2391
mid $\cdot \hat{P}(X)$	0.163	0.5326	0.587	0.9565	0.5652	0.9783	1.1087	0.8261	0.2283	0	0	0.2935		$\hat{E}(Y)$		81.5217

The individual probability from the table comes from dividing frequency with the number of samples.  $P[X]$  comes from summing the data for all columns.  $P[Y]$  comes from summing the data for all rows. The expected value of  $X$  ( $E[X]$ ) is 6.23913 which is calculated by summing all of  $P[X]$  and the expected value of  $Y$  ( $E[Y]$ ) is 61.3043 which is calculated by summing all of  $P[Y]$ .



The correlation coefficient is computed by using the formula

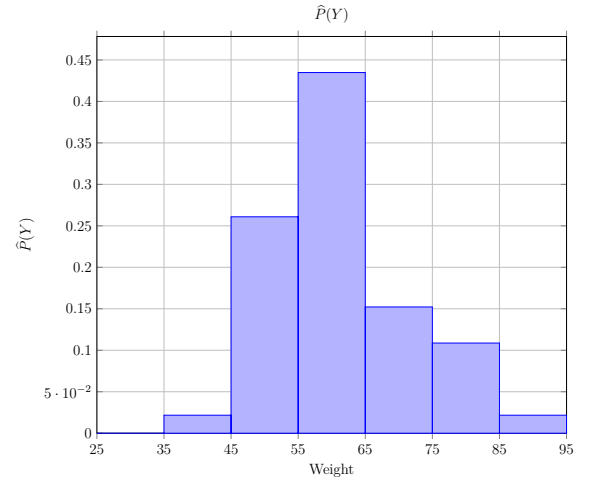
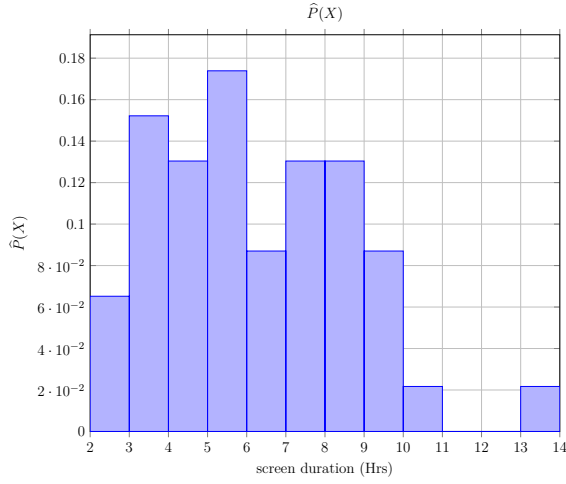
$$\hat{\rho}_{X,Y} = \frac{\hat{S}_{X,Y}}{s_X s_Y} \quad \& \quad \hat{S}_{X,Y} = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{X})(y_i - \bar{Y})$$

In this case,  $\bar{X} = 6.271, \bar{Y} = 80.7174, n = 46, s_x = 2.4862, s_y = 10.8805$ . Therefore,  $S_{X,Y} = -1.3246$  and  $r = -0.0490$ . Thus, the relation between  $X$  and  $Y$  has a weak negative relationship.

## Screen time vs Weight

$\begin{matrix} \backslash & x \\ y \end{matrix}$		2	3	4	5	6	7	8	9	10	11	12	13	$\hat{P}(Y)$	midpoint	mid $\cdot \hat{P}(Y)$
		3	4	5	6	7	8	9	10	11	12	13	14			
25	35	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0
35	45	0	0	0	0	0	0	0.0217	0	0	0	0	0	0.0217	40	0.8696
45	55	0	0.1087	0	0.0652	0	0.0435	0.0217	0.0217	0	0	0	0	0.2609	50	13.0435
55	65	0.0435	0.0217	0.0652	0.087	0	0.0435	0.0652	0.0652	0.0217	0	0	0.0217	0.4348	60	26.087
65	75	0.0217	0	0.0435	0.0217	0.0435	0.0217	0	0	0	0	0	0	0.1522	70	10.6522
75	85	0	0	0.0217	0	0.0435	0.0217	0.0217	0	0	0	0	0	0.1087	80	8.6957
85	95	0	0.0217	0	0	0	0	0	0	0	0	0	0	0.0217	90	1.9565
$\hat{P}(X)$		0.0652	0.1522	0.1304	0.1739	0.087	0.1304	0.1304	0.087	0.0217	0	0	0.0217			
midpoint		2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5		$\hat{E}(X)$	6.2391
mid $\cdot \hat{P}(X)$		0.163	0.5326	0.587	0.9565	0.5652	0.9783	1.1087	0.8261	0.2283	0	0	0.2935		$\hat{E}(Y)$	61.3043

The individual probability from the table comes from dividing frequency with the number of samples.  $P[X]$  comes from summing the data for all columns.  $P[Y]$  comes from summing the data for all rows. The expected value of  $X$  ( $E[X]$ ) is 6.23913 which is calculated by summing all of  $P[X]$  and the expected value of  $Y$  ( $E[Y]$ ) is 61.3043 which is calculated by summing all of  $P[Y]$ .



The correlation coefficient is computed by using the formula

$$\hat{\rho}_{X,Y} = \frac{\hat{S}_{X,Y}}{s_X s_Y} \quad \& \quad \hat{S}_{X,Y} = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{X})(y_i - \bar{Y})$$

In this case,  $\bar{X} = 6.271$ ,  $\bar{Y} = 61.0587$ ,  $n = 46$ ,  $s_x = 2.4862$ ,  $s_y = 10.3099$ . Therefore,  $S_{X,Y} = -0.3518$  and  $r = -0.0137$ . Thus, the relation between  $X$  and  $Y$  has a weak negative relationship.



	Age	Average daily screen time (Hrs)	Average daily notification received	Weight (Kg)	Heart Rate	Sleeping time (Hrs)
Count	55	55	55	55	55	55
MEAN	29.1818	6.5771	103.7506	61.9709	80.8909	7.3098
median	21	6.2024	86	60.000	83	7.34
mode	19	6.2024	86	50.000	87	6.50
MIN	7	2.2357	6.4286	25.70	51	4.50
MAX	57	16.6714	357	111.1	111	10.5333
range	50	14.4357	350.5714	85.4	60	6.0333
variance	175.4478	7.9495	5585.4741	194.314	168.4323	1.4176
SD	13.2457	2.8195	74.736	13.9397	12.9781	1.1906
cv	0.4539	0.4287	0.7203	0.2249	0.1604	0.1629
MAD	11.7752	2.2193	56.0073	9.9298	9.9451	0.8687
quartile1 (Q1)	19	4.569	49.1429	52.5	73	6.5
quartile3 (Q3)	43	8.3167	146.7143	67	88	8
IQR	24	3.7476	97.5714	14.5	15	1.5
Q1-1.5IQR	-17	-1.0524	-97.2143	30.75	50.5	4.25
Q3+1.5IQR	79	13.9381	293.0714	88.75	110.5	10.25
Outliers (based on IQR) If no outlier, answer None.	None	16.671	294.857, 357	25.7, 93, 111.1	111	10.417, 10.533
MEAN-3SD	-10.5552	-1.8814	-120.4574	20.1519	41.9565	3.7379
MEAN+3SD	68.9188	15.0355	327.9587	103.7899	119.8254	10.8818
Outliers (based on SD) If no outlier, answer None.	None	16.6714	357	111.1	None	None
Mean after removing outliers based on IQR. If no outlier, type NA	NA	6.3901	95.3666	61.1269	80.3333	7.1904
SD after removing outliers based on IQR. If no outlier, type NA	NA	2.4782	61.5869	10.6309	12.4173	1.0355
Measure of Centrality	Median					
Reason	The data is right-skewed				The data is left-skewed	
Measure of Dispersion	IQR					
Reason	The data is skewed	The dataset has an outlier				

## Statistics

### Descriptive Statistics

### Goodness of Fit test

#### 1. Data set : Average screen duration

Type of distribution : Normal distribution

Known parameter : 0

Unknown parameter ( $m$ ) : 2, which are  $\mu, \sigma$

$H_0$  : Screen duration is normally distributed with  $\mu = 6.2709$  and  $\sigma = 2.4862$

$H_a$  : Screen duration is not normally distributed with  $\mu = 6.2709$  and  $\sigma = 2.4862$

Number of cells with the expected number of samples ( $k$ ) : 6

$$\text{Test static } \chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} = 2.0956$$

Significant level ( $\alpha$ ) : 0.05

Degree of freedom 1 ( $\nu_1$ ) :  $k - 1 - m = 6 - 1 - 2 \Rightarrow 3$

Cutoff of non-rejection region : 7.8147

Degree of freedom 2 ( $\nu_2$ ) :  $k - 1 = 6 - 1 \Rightarrow 5$

Cutoff of rejection region : 11.070

Non-rejection regions :  $\chi^2 < \chi_{0.05,3}^2 = 7.8147$

Rejection regions :  $\chi^2 \geq \chi_{0.05,5}^2 = 11.070$

Rejection decision : Don't need to reject null hypothesis

Conclusion : Screen duration is normally distributed with  $\mu = 6.2709$  and  $\sigma = 2.4862$

#### 2. Data set : Average Sleeping Duration

Type of distribution : Normal distribution

Known parameter : 0

Unknown parameter ( $m$ ) : 2, which are  $\mu, \sigma$

$H_0$  : Screen duration is normally distributed with  $\mu = 7.2178$  and  $\sigma = 1.0068$

$H_a$  : Screen duration is not normally distributed with  $\mu = 7.2178$  and  $\sigma = 1.0068$

Number of cells with the expected number of samples ( $k$ ) : 4

$$\text{Test static } \chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} = 1.3428$$

Significant level ( $\alpha$ ) : 0.05

Degree of freedom 1 ( $\nu_1$ ) :  $k - 1 - m = 4 - 1 - 2 \Rightarrow 1$

Cutoff of non-rejection region : 3.8415

Degree of freedom 2 ( $\nu_2$ ) :  $k - 1 = 4 - 1 \Rightarrow 3$

Cutoff of rejection region : 7.8147

Non-rejection regions :  $\chi^2 < \chi_{0.05,1}^2 = 3.8415$

Rejection regions :  $\chi^2 \geq \chi_{0.05,3}^2 = 7.8147$

Rejection decision : Don't need to reject null hypothesis

Conclusion : Screen duration is normally distributed with  $\mu = 7.2178$  and  $\sigma = 1.0068$

### 3. Data set : Weight

Type of distribution : Normal distribution

Known parameter : 0

Unknown parameter ( $m$ ) : 2, which are  $\mu, \sigma$

$H_0$  : Screen duration is normally distributed with  $\mu = 61.0587$  and  $\sigma = 10.3099$

$H_a$  : Screen duration is not normally distributed with  $\mu = 61.0587$  and  $\sigma = 10.3099$

Number of cells with the expected number of samples ( $k$ ) : 6

$$\text{Test static } \chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} = 3.1761$$

Significant level ( $\alpha$ ) : 0.05

Degree of freedom 1 ( $\nu_1$ ) :  $k - 1 - m = 6 - 1 - 2 \Rightarrow 3$

Cutoff of non-rejection region : 7.8147

Degree of freedom 2 ( $\nu_2$ ) :  $k - 1 = 6 - 1 \Rightarrow 5$

Cutoff of rejection region : 11.070

Non-rejection regions :  $\chi^2 < \chi_{0.05,3}^2 = 7.8147$

Rejection regions :  $\chi^2 \geq \chi_{0.05,5}^2 = 11.070$

Rejection decision : Don't need to reject null hypothesis

Conclusion : Screen duration is normally distributed with  $\mu = 61.0587$  and  $\sigma = 10.3099$

### 4. Data set : Average Notification

Type of distribution : Normal distribution

Known parameter : 0

Unknown parameter ( $m$ ) : 2, which are  $\mu, \sigma$

$H_0$  : Screen duration is normally distributed with  $\mu = 93.7671$  and  $\sigma = 56.1233$

$H_a$  : Screen duration is not normally distributed with  $\mu = 93.7671$  and  $\sigma = 56.1233$

Number of cells with the expected number of samples ( $k$ ) : 6

$$\text{Test static } \chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} = 1.4815$$

Significant level ( $\alpha$ ) : 0.05

Degree of freedom 1 ( $\nu_1$ ) :  $k - 1 - m = 6 - 1 - 2 \Rightarrow 3$

Cutoff of non-rejection region : 7.8147

Degree of freedom 2 ( $\nu_2$ ) :  $k - 1 = 6 - 1 \Rightarrow 5$

Cutoff of rejection region : 11.070

Non-rejection regions :  $\chi^2 < \chi_{0.05,3}^2 = 7.8147$

Rejection regions :  $\chi^2 \geq \chi_{0.05,5}^2 = 11.070$

Rejection decision : Don't need to reject null hypothesis

Conclusion : Screen duration is normally distributed with  $\mu = 93.7671$  and  $\sigma = 56.1233$

## Hypothesis Test

### 1. Data set : Average screen duration

Test hypothesis claims that *average screen duration* is greater than 7 Hrs.

Collect data from 55 people. Sample mean sample standard deviation : 6.5771 & 2.8195 Hrs respectively.

Case of Hypothesis test : Large sample size

Upper-tailed, lower-tailed or two-tailed test : upper-tailed

#### 7 steps test

##### 1.1 Choose parameter of interest ( $\mu$ )

Parameter :  $\mu$

##### 1.2 Specify null value ( $\mu_0$ ) and null hypothesis ( $H_0$ )

$\mu$  : average screen duration

$$\mu_0 : 7 \tag{1}$$

$$H_0 : \mu = 7$$

##### 1.3 State alternative hypothesis ( $H_a$ )

$$H_a : \mu > 7 \tag{2}$$

##### 1.4 Compute test statistic ( $z$ )

$$z = \frac{\bar{X} - \mu_0}{\frac{S}{\sqrt{n}}} = \frac{6.2709 - 7}{\frac{2.4862}{\sqrt{46}}} \Rightarrow -1.989 \tag{3}$$

##### 1.5 Indicate significance level ( $\alpha$ ) and find rejection region ( $z_a$ )

$$\alpha : 0.05$$

$$\begin{aligned}
1 - \alpha &= 1 - 0.05 &= 0.95 \\
z_a &= z_{0.05} &= 1.6449 \\
z &\geq 1.6449
\end{aligned} \tag{4}$$

1.6 Determine whether we reject null hypothesis or not

Test static does not fall inside the rejection region. Null hypothesis is not rejected.

1.7 Conclude the problem

We do not reject the null hypothesis. Average screen duration is 7 Hrs.

## 2. Data set : Average notification

Test hypothesis claims that *average notification* is greater than 100 times.

Collect data from 55 people. Sample mean sample standard deviation : 103.7506 & 74.7360 times respectively.

Case of Hypothesis test : Large sample size

Upper-tailed, lower-tailed or two-tailed test : upper-tailed

### 7 steps test

2.1 Choose parameter of interest ( $\mu$ )

Parameter :  $\mu$

2.2 Specify null value ( $\mu_0$ ) and null hypothesis ( $H_0$ )

$$\begin{aligned}
\mu &: \text{average notification} \\
\mu_0 &: 100 \\
H_0 &: \mu = 100
\end{aligned} \tag{5}$$

2.3 State alternative hypothesis ( $H_a$ )

$$H_a : \mu > 100 \tag{6}$$

2.4 Compute test statistic ( $z$ )

$$z = \frac{\bar{X} - \mu_0}{\frac{S}{\sqrt{n}}} = \frac{93.7671 - 100}{\frac{56.1233}{\sqrt{46}}} \Rightarrow -0.7532 \tag{7}$$

2.5 Indicate significance level ( $\alpha$ ) and find rejection region ( $z_a$ )

$$\begin{aligned}
\alpha &: 0.01 \\
1 - \alpha &= 1 - 0.05 &= 0.99 \\
z_a &= z_{0.01} &= 2.3263 \\
z &\geq 2.3263
\end{aligned} \tag{8}$$

2.6 Determine whether we reject null hypothesis or not

Test static does not fall inside the rejection region. Null hypothesis is not rejected.

2.7 Conclude the problem

We do not reject the null hypothesis. Average notification is 100 times.

# Conclusion

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# Appendix

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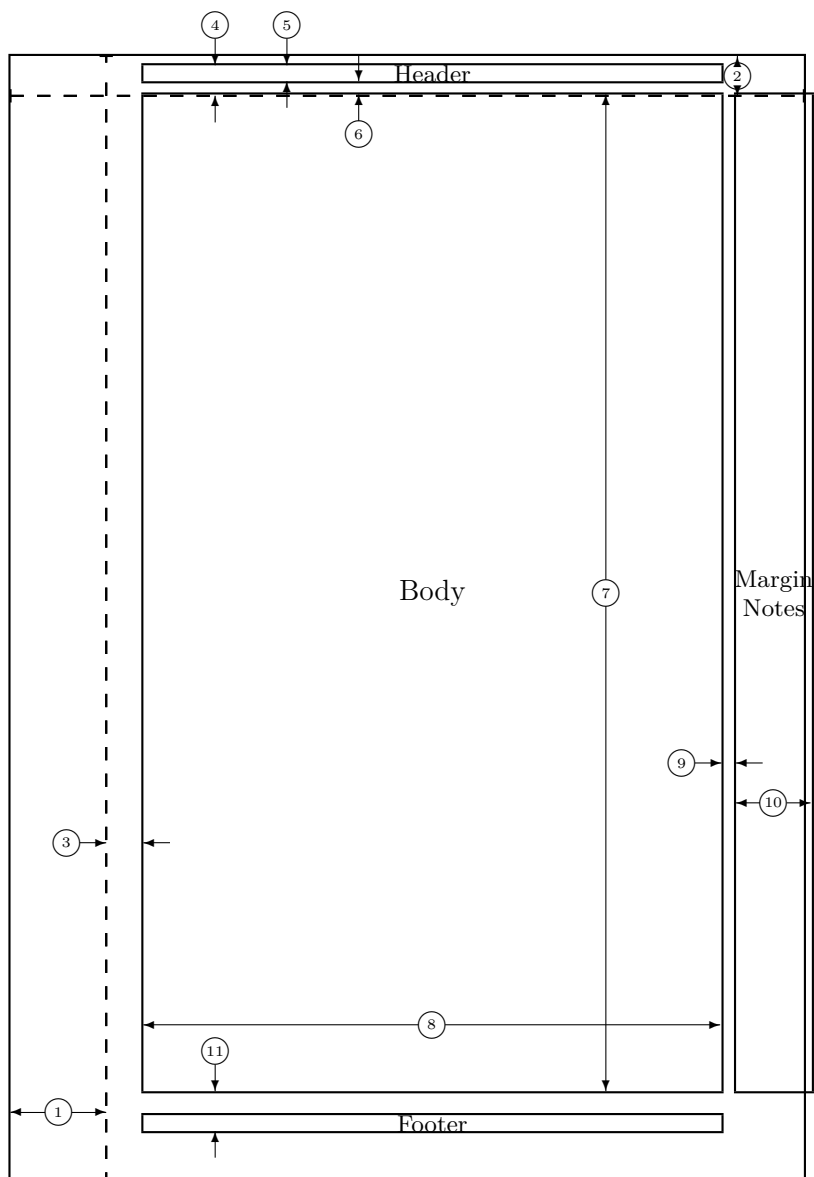
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| 3  | \oddsidemargin = 28pt | 4  | \topmargin = -23pt               |
| 5  | \headheight = 12pt    | 6  | \headsep = 10pt                  |
| 7  | \textheight = 750pt   | 8  | \textwidth = 435pt               |
| 9  | \marginparsep = 11pt  | 10 | \marginparwidth = 57pt           |
| 11 | \footskip = 30pt      |    | \marginparpush = 5pt (not shown) |
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