Research on Relationship between Sleep Quality and Academic Performance

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Pre-Interviews

Do you ever tried to arrange a reasonable rest schedule?

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8:00 - 12:00	12:00 – 14:00	14:00 – 18:00	18:00 – 22:00	22:00 – 0:00	0:00
Morning Class	Nap Time	Afternoon class	Study/Entertain.	Prepare for Bed!	Self.goToBed()!

(Reported from 10 students in CSC3001 Discrete Mathematics, 2018)

Pre-Interviews

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8:00 - 12:00	12:00 – 14:00	14:00 – 18:00	18:00 – 22:00	22:00 – 0:00	0:00 – 2:00
Morning Class	Nap Time	Afternoon class	Study/Entertain.	Prepare for Bed!	Self.goToBed()!!!!

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Pre-Interviews

Do you ever tried to arrange a reasonable rest schedule?

	2:00	12:00 – 14:00	14:00 – 18:00	18:00 – 22:00	22:00 – 0:00	0:00 – 8:00
	Class	Nap Time	Afternoon class	Study/Entertain.	Prepare for Bed!	Self.goToBed()!!!!

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Claim 1. Those **who sleep late have more time** in school **works**, and therefore they can dedicate more time in studying, which will lead to **higher GPAs**.

Is Claim 1 true?

Claim 2. Difficulties in keeping a stable rest schedule might indicates a **poor time management**, and less sleep durations will **decrease the efficiency of studying**, which will eventually contribute to **lower GPAs**.

Is Claim 2 true?

Relative Researches

Q1. What are the reasons for CUHK(SZ) student staying up late?

Q2. Explore the relationship between staying up late and academic performance.

Q3. Explore the respective relationships between academic performance and each distinct reason.

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Table 1
Studies assessing the relationship between sleep quality and school performance included in the analysis.

Author	Year	*N*	% Boys	Mean age	Sleep assessment	School performance assessment	*r*	*z*
Al-Sharbati[44]	2002	277	65.34	10.50	Self-report	Self-report	0.196	0.199
BaHammam et al.[45]	2006	1012	50.50	9.50	Parent report	Parent report	0.133	0.134
Bruni et al.[46]	2006	262	53.41	9.60	Parent report	Teacher report	0.168	0.170
Chung & Cheung[47]	2008	1339	50.76	14.82	Self-report	Self-report	0.041	0.041
Giannotti et al.[48]	1997	3040	40.52	17.00	Self-report	Self-report	0.060	0.060
Horn & Dollinger[49]	1989	239	49.79	12.00	Self-report	Grades	0.000	0.000
Keller et al.[32]	2008	124	46.00	8.73	Actigraphy	Standardized tests	0.153	0.154
Lazaratou et al.[50]	2005	713	44.46	16.50	Self-report	Self-report	0.120	0.121
Mayes et al.[51]	2008	412	52.00	8.60	Polysomnography	Standardized tests	−0.060	−0.060
Meijer & van den Wittenboer[52]	2004	127	52.94	11.70	Self-report	Self-report	0.048	0.048
Meijer[18]	2008	378	50.46	11.50	Self-report	Self-report	0.194	0.196
Meijer[53]	2008	158	61.40	14.55	Self-report	Grades	0.192	0.194
Pagel et al.[9]	2008	165	50.00	14.00	Self-report	Self-report	0.000	0.000
Salcedo Aguilar et al.[54]	2005	1155	46.49	14.00	Self-report	Self-report	0.088	0.088
Warner et al.[55]	2008	310	36.00	16.04	Self-report	Self-report	0.054	0.054
Wiater et al.[28]	2008	3920	n.a.	10.00	Self-report/parent report	Parent report	0.148	0.149

N = sample size; *r* = Pearson's correlation coefficient; *z* = Fisher's z transformation of Pearson's correlation coefficient; n.a. = not available.

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Table 5
Moderators of effect sizes for studies on sleep duration.

Moderator	*k*	*r*	*β*	Qb	Qw
Age					
Fixed	17	0.071	−0.400*	5.454*	29.213**
Random	17	0.069	−0.345	2.272	16.786
Gender (% boys)					
Fixed	15	0.076	0.284	2.267	25.928*
Random	15	0.075	0.199	0.6627	16.017
Age*gender	15	0.076		10.926*	17.268
Fixed					
Age			−0.591*		
Gender			−0.237		
Age*gender			0.587*		
Random	15	0.075		7.870	11.558
Age			−0.526*		
Gender			−0.337		
Age*gender			0.652*		
Objectivity of school performance assessment					
Fixed	17	0.071	0.055	0.104	34.563**
Random	17	0.069	0.207	0.709	15.778
Method of sleep assessment					
Fixed	16	0.070		0.016	32.760**
Self-report (*k* = 12)			Reference		
Parent report (*k* = 4)			−0.022		
Random	16	0.067		0.055	15.195
Self-report (*k* = 12)			Reference		
Parent report (*k* = 4)			−0.06		
Method of school performance assessment					
Fixed	16	0.073		0.758	28.630**
Self-report (*k* = 11)			Reference		
Parent report (*k* = 2)			0.159		
Objective measurement (*k* = 3)			0.062		
Random	16	0.074		0.867	12.540
Self-report (*k* = 11)			Reference		
Parent report (*k* = 2)		0.176			
Objective measurement (*k* = 3)		0.217			

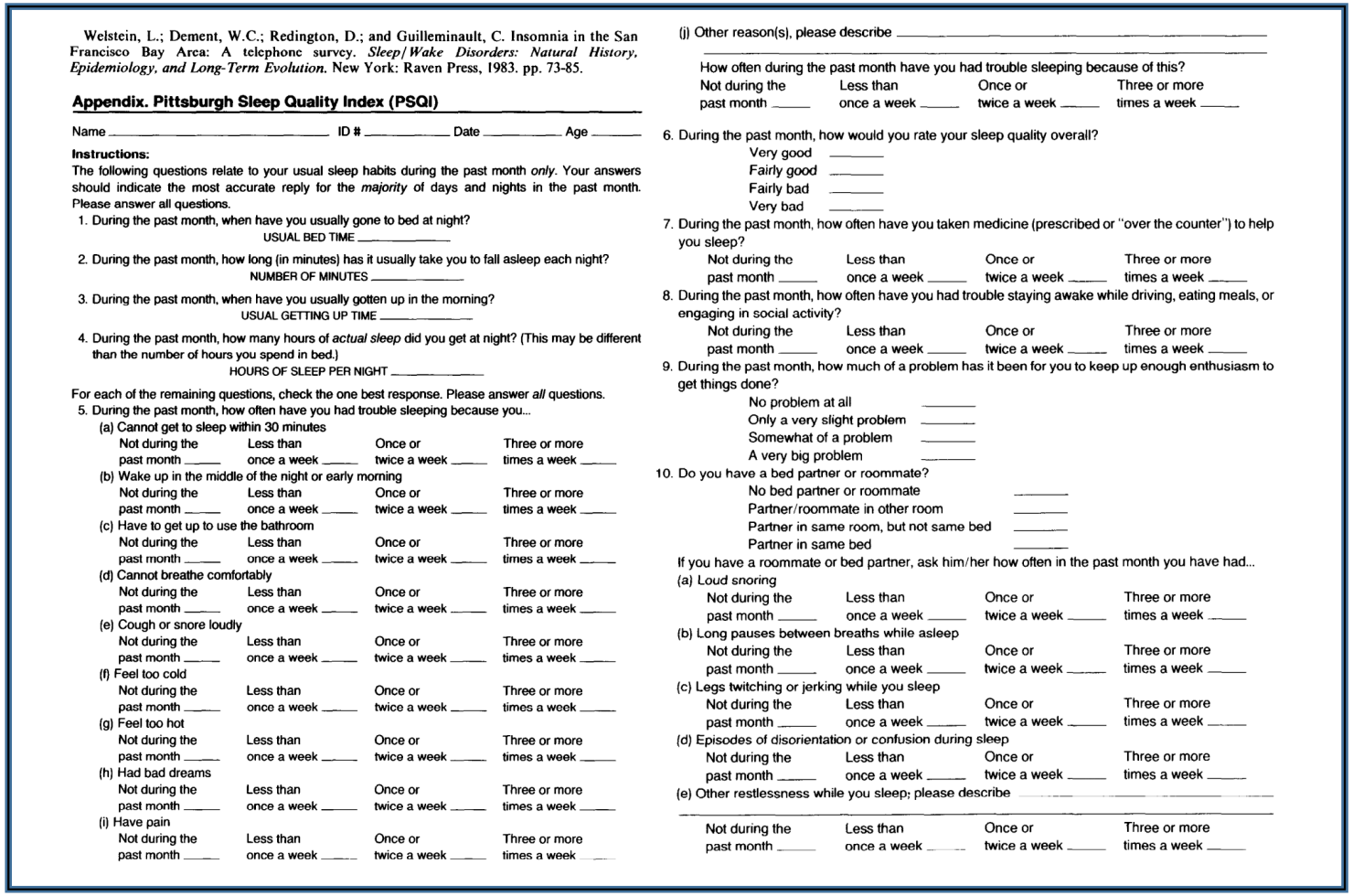
k = number of studies; *r* = correlation coefficient, Qb = Q statistic between studies (index of variability between the group means); Qw = Q statistic within studies (index of variability within the groups).
* $p < 0.05$. ** $p < 0.01$.

(Julia F. Dewald, et al. 2010)

Methods – Sleep Quality Index

Pittsburgh Sleep Quality Index (PSQI)

A scientific and quantitive index to measure the sleep qualities of responders, which was proposed by Daniel J. Buysse, Charles F. Reynolds, Timothy H. Monk, Susan R. Berman and David J. Kupfer in 1988.



Welstein, L.; Dement, W.C.; Redington, D.; and Guilleminault, C. Insomnia in the San Francisco Bay Area: A telephone survey. *Sleep/Wake Disorders: Natural History, Epidemiology, and Long-Term Evolution.* New York: Raven Press, 1983. pp. 73-85.

Appendix. Pittsburgh Sleep Quality Index (PSQI)

Name _____ ID # _____ Date _____ Age _____

Instructions:
The following questions relate to your usual sleep habits during the past month *only*. Your answers should indicate the most accurate reply for the *majority* of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?
   USUAL BED TIME _____
2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?
   NUMBER OF MINUTES _____
3. During the past month, when have you usually gotten up in the morning?
   USUAL GETTING UP TIME _____
4. During the past month, how many hours of *actual sleep* did you get at night? (This may be different than the number of hours you spend in bed.)
   HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer *all* questions.

5. During the past month, how often have you had trouble sleeping because you...
   (a) Cannot get to sleep within 30 minutes
   (b) Wake up in the middle of the night or early morning
   (c) Have to get up to use the bathroom
   (d) Cannot breathe comfortably
   (e) Cough or snore loudly
   (f) Feel too cold
   (g) Feel too hot
   (h) Had bad dreams
   (i) Have pain

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a)	_____	_____	_____	_____
(b)	_____	_____	_____	_____
(c)	_____	_____	_____	_____
(d)	_____	_____	_____	_____
(e)	_____	_____	_____	_____
(f)	_____	_____	_____	_____
(g)	_____	_____	_____	_____
(h)	_____	_____	_____	_____
(i)	_____	_____	_____	_____

   (j) Other reason(s), please describe _____

   How often during the past month have you had trouble sleeping because of this?

Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
_____	_____	_____	_____

6. During the past month, how would you rate your sleep quality overall?
   Very good _____
   Fairly good _____
   Fairly bad _____
   Very bad _____
7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?
9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?
   No problem at all _____
   Only a very slight problem _____
   Somewhat of a problem _____
   A very big problem _____
10. Do you have a bed partner or roommate?
    No bed partner or roommate _____
    Partner/roommate in other room _____
    Partner in same room, but not same bed _____
    Partner in same bed _____

    If you have a roommate or bed partner, ask him/her how often in the past month you have had...
    (a) Loud snoring
    (b) Long pauses between breaths while asleep
    (c) Legs twitching or jerking while you sleep
    (d) Episodes of disorientation or confusion during sleep
    (e) Other restlessness while you sleep; please describe _____

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a)	_____	_____	_____	_____
(b)	_____	_____	_____	_____
(c)	_____	_____	_____	_____
(d)	_____	_____	_____	_____
(e)	_____	_____	_____	_____

Sample PSQI Questionnaire I (Buysse, D. J, et al., 1989)

Methods – Sleep Quality Index

19 self-rated questions
~~5 questions rated by the bed partner~~

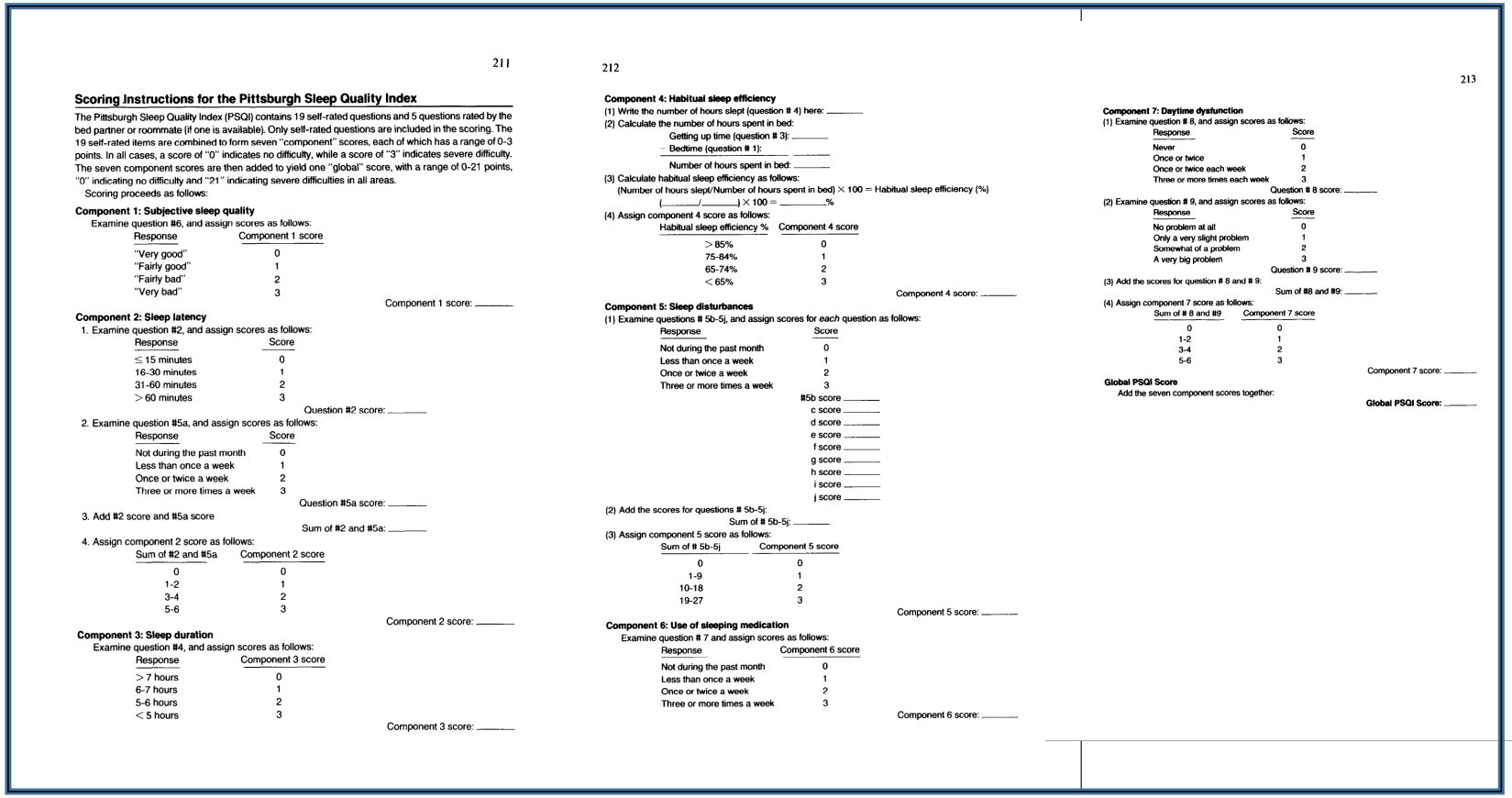
Components:

- Subjective sleep quality
- Sleep latency
- Sleep duration
- Habitual sleep efficiency
- Sleep disturbances
- Use of sleeping medication
- Daytime dysfunction

Each component answer has a range of 0-3, where

- **"0" indicates no difficulty**
- **"3" indicates severe difficulty**

Full Score: 21



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Scoring Instructions for the Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) contains 19 self-rated questions and 5 questions rated by the bed partner or roommate (if one is available). Only self-rated questions are included in the scoring. The 19 self-rated items are combined to form seven "component" scores, each of which has a range of 0-3 points. In all cases, a score of "0" indicates no difficulty, while a score of "3" indicates severe difficulty. The seven component scores are then added to yield one "global" score, with a range of 0-21 points, "0" indicating no difficulty and "21" indicating severe difficulties in all areas.

Scoring proceeds as follows:

Component 1: Subjective sleep quality

Examine question #6, and assign scores as follows:

Response	Component 1 score
"Very good"	0
"Fairly good"	1
"Fairly bad"	2
"Very bad"	3

Component 1 score: _____

Component 2: Sleep latency

1. Examine question #2, and assign scores as follows:

Response	Score
≤ 15 minutes	0
16-30 minutes	1
31-60 minutes	2
> 60 minutes	3

Question #2 score: _____

2. Examine question #5a, and assign scores as follows:

Response	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Question #5a score: _____

3. Add #2 score and #5a score

Sum of #2 and #5a: _____

4. Assign component 2 score as follows:

Sum of #2 and #5a	Component 2 score
0	0
1-2	1
3-4	2
5-6	3

Component 2 score: _____

Component 3: Sleep duration

Examine question #4, and assign scores as follows:

Response	Component 3 score
> 7 hours	0
6-7 hours	1
5-6 hours	2
< 5 hours	3

Component 3 score: _____

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Component 4: Habitual sleep efficiency

(1) Write the number of hours slept (question # 4) here: _____

(2) Calculate the number of hours spent in bed:

Getting up time (question # 3): _____

Bedtime (question # 1): _____

Number of hours spent in bed: _____

(3) Calculate habitual sleep efficiency as follows:

(Number of hours slept/Number of hours spent in bed) × 100 = Habitual sleep efficiency (%)

(_____/_____) × 100 = _____%

(4) Assign component 4 score as follows:

Habitual sleep efficiency %	Component 4 score
> 85%	0
75-84%	1
65-74%	2
< 65%	3

Component 4 score: _____

Component 5: Sleep disturbances

(1) Examine questions # 5b-5j, and assign scores for *each* question as follows:

Response	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

#5b score _____
c score _____
d score _____
e score _____
f score _____
g score _____
h score _____
i score _____
j score _____

(2) Add the scores for questions # 5b-5j:

Sum of # 5b-5j: _____

(3) Assign component 5 score as follows:

Sum of # 5b-5j	Component 5 score
0	0
1-9	1
10-18	2
19-27	3

Component 5 score: _____

Component 6: Use of sleeping medication

Examine question # 7 and assign scores as follows:

Response	Component 6 score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Component 6 score: _____

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Component 7: Daytime dysfunction

(1) Examine question # 8, and assign scores as follows:

Response	Score
Never	0
Once or twice	1
Once or twice each week	2
Three or more times each week	3

Question # 8 score: _____

(2) Examine question # 9, and assign scores as follows:

Response	Score
No problem at all	0
Only a very slight problem	1
Somewhat of a problem	2
A very big problem	3

Question # 9 score: _____

(3) Add the scores for question # 8 and # 9:

Sum of #8 and #9: _____

(4) Assign component 7 score as follows:

Sum of # 8 and #9	Component 7 score
0	0
1-2	1
3-4	2
5-6	3

Component 7 score: _____

Global PSQI Score

Add the seven component scores together:

Global PSQI Score: _____

Sample PSQI Questionnaire II (Buysse, D. J, et al., 1989)

Methods – Academic Performance Index

1. Self-reported GPA (Grade-Point Average)

- Advantage: simple way to evaluate responders academic performance – doable
- Shortcoming: not reliable and accurate enough

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If the collected result can be cross-verified in the end, that would be nice…

Methods – Correlation Analysis

Calculation of Correlation Coefficient

- Negative **ρ** indicates a negative correlation
- Positive **ρ** indicates a positive correlation

Closer the absolute value of **ρ** to 1, higher probability there is a correlation between two variables

(a) If $u(X, Y) = (X - \mu_X)(Y - \mu_Y)$, then

$$E[u(X, Y)] = E[(X - \mu_X)(Y - \mu_Y)] = \sigma_{XY} = \text{Cov}(X, Y)$$

is called the **covariance** of X and Y.

(b) If the standard deviations σ_X and σ_Y are positive, then

$$\rho = \frac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$$

is called the **correlation coefficient** of X and Y.

It is convenient that the mean and the variance of X can be computed from either the joint pmf (or pdf) or the marginal pmf (or pdf) of X. For example, in the discrete case,

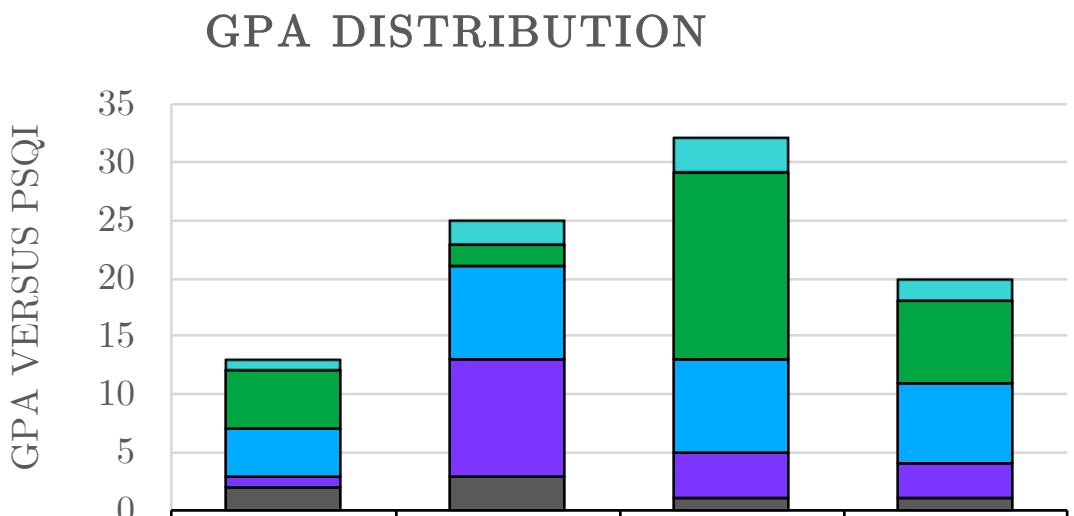
$$\mu_X = E(X) = \sum_x \sum_y x f(x, y)$$

$$= \sum_x x \left[\sum_y f(x, y) \right] = \sum_x x f_X(x).$$

Formulas of Correlation Coefficient

Data Analysis

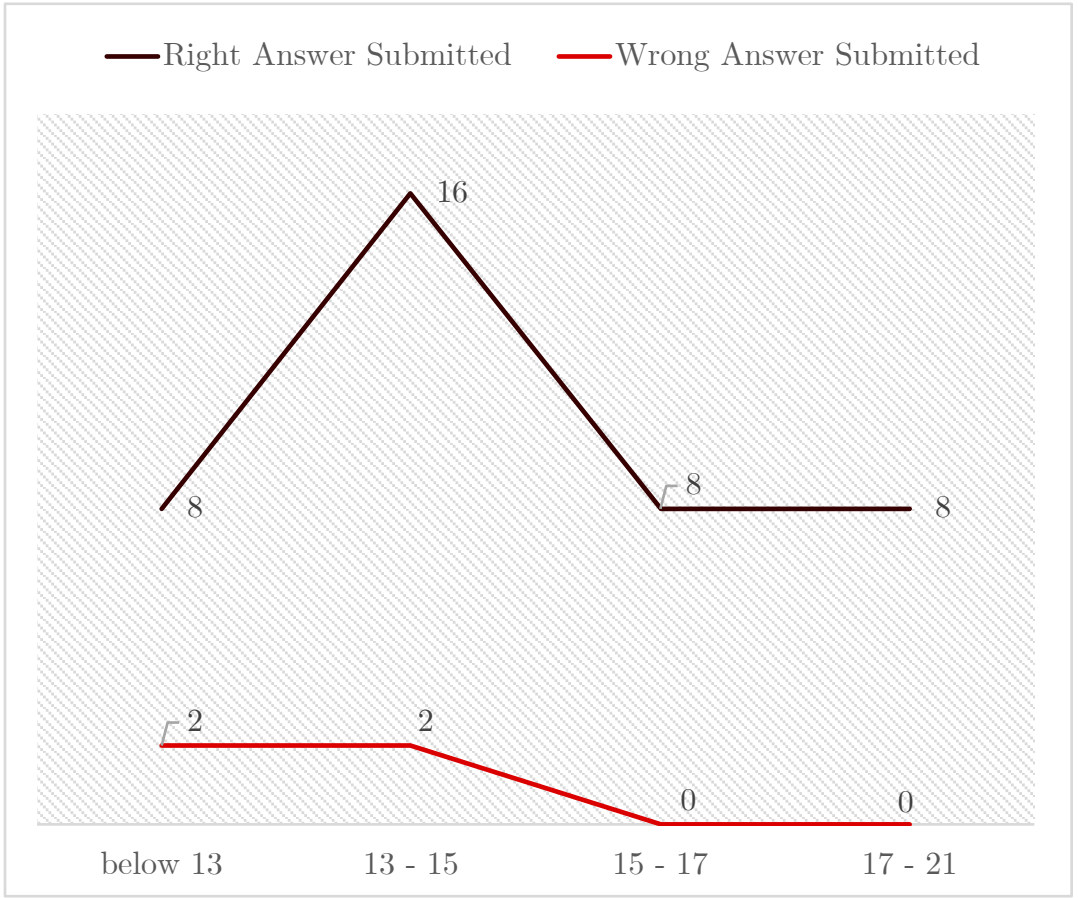
1. Questionnaire on GPA and PSQI from 91 students



	below 13	13 - 15	15 - 17	17 - 21
GPA 3.7 - 4.0	1	2	3	2
GPA 3.4 - 3.7	5	2	16	7
GPA 3.0 - 3.4	4	8	8	7
GPA 2.7 - 3.0	1	10	4	3
GPA below 2.7	2	3	1	1

2. Questionnaire on PSQI in MAT2040 Lecture

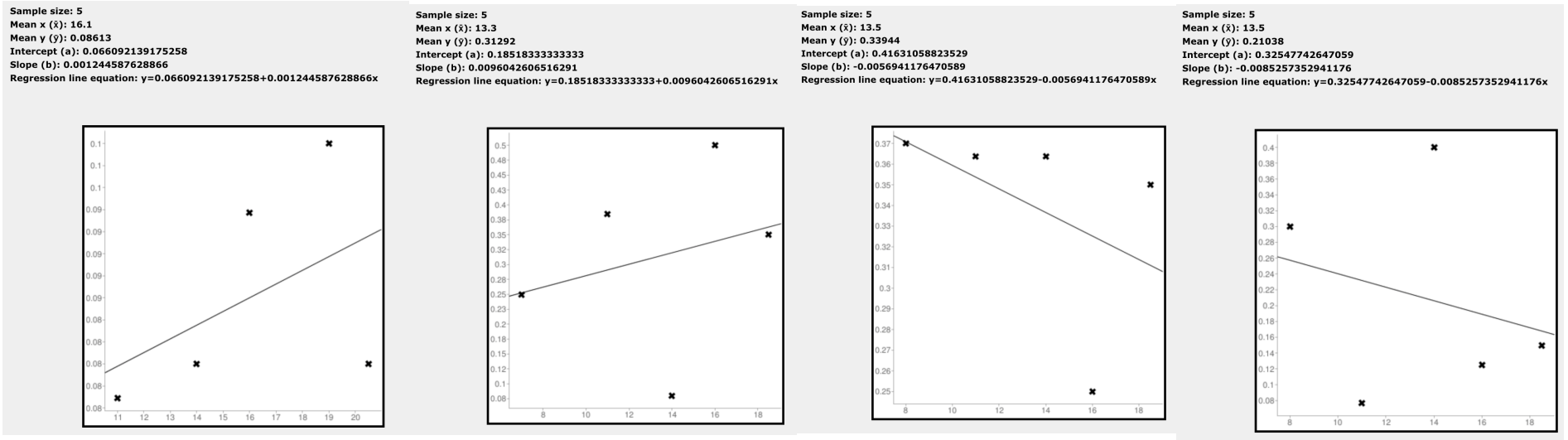
44 submissions



Correlation Analysis

GPA Interval	4.0 – 3.7	3.7 – 3.4	3.4 – 3.0	3.0 – 2.7
Correlation Coefficient	0.4685	0.2717	-0.4646	-0.2607

Correlation Table and Linear Regression Graph



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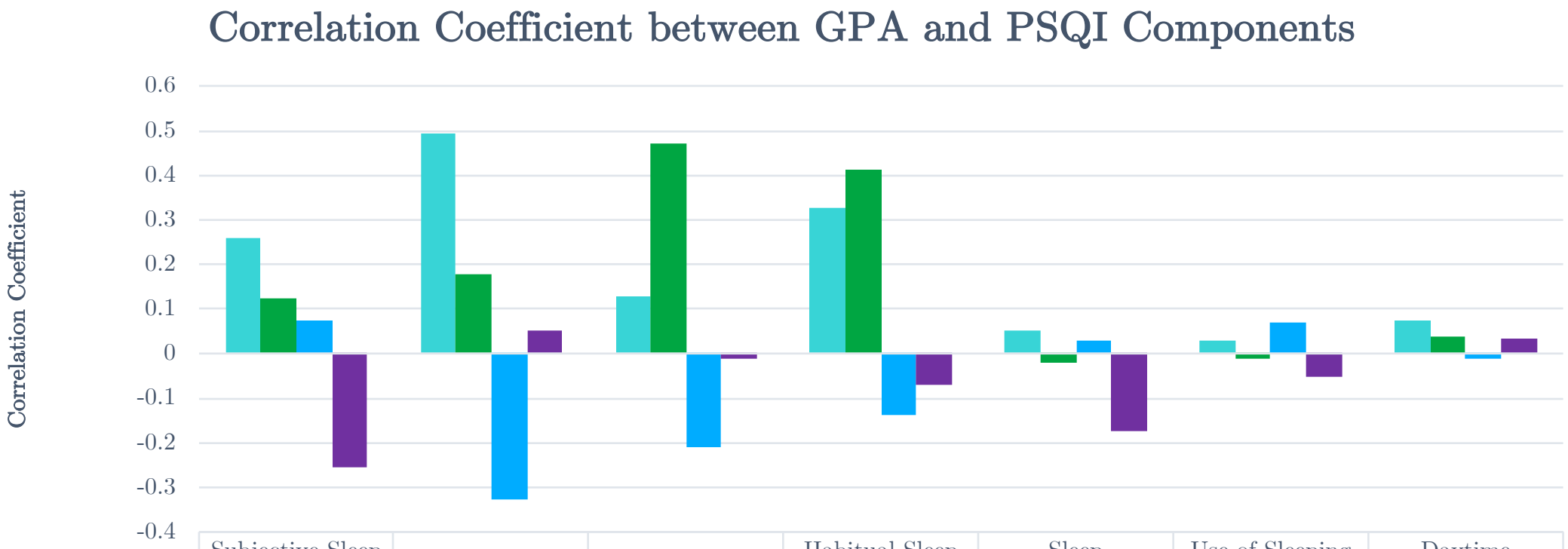

	Subjective Sleep Quality	Sleep Latency	Sleep Duration	Habitual Sleep Efficiency	Sleep Distributions	Use of Sleeping Medication	Daytime Dysfunction
GPA 4 - 3.7	0.257	0.495	0.127	0.327	0.05	0.027	0.075
GPA 3.7 - 3.4	0.125	0.178	0.47	0.412	-0.02	-0.01	0.04
GPA 3.4 - 3.0	0.075	-0.328	-0.21	-0.14	0.03	0.07	-0.01
GPA 3.0 - 2.7	-0.254	0.05	-0.013	-0.07	-0.175	-0.05	0.035

Summary

During the research we found that,

1. Sleep quality do have correlation with self-reported GPA, that better sleep qualities correlate to higher GPA and worse sleep qualities correlate to lower GPA.
   (This result can also be cross-verified by MAT2040 in-class evaluation.)

2. Among contributed factors in PSQI report, we found that subjective sleep qualities and sleep latency have significant impact on self-reported GPA.
   (Since there are only 4 wrong answer submissions in MAT2040 in-class evaluation, correlation analysis in this part is aborted.)

More Information About Research?

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Current Work: Communication System Dev. & Network Coding

My WeChat QR Code