

THE MINIMUM SCORE PREDICTION FOR THE CONSORTIUM OF THAI MEDICAL SCHOOLS (COTMES) FACULTY QUALIFICATION BY THE N-METHOD IN THE YEARS 2021-2023

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Abstract

The Thai University Central Admission System (TCAS) is accessible to all high school students in Thailand. The TCAS acceptance procedure consists of four rounds: portfolio, quota, admission, and direct admission. The admission round uses the score of each test subject to compute the total score, allowing students to then apply to join the TCAS. The Consortium of Thai Medical Schools (COTMES) is a group at the Faculty of Medicine, Dentistry, Veterinary Medicine, and Pharmacy which selects students through the admission round of the TCAS using the same score criteria. The minimum score that can qualify for admission is the main criterion. However, the minimum score of the previous year cannot be used directly due to the varying levels of difficulty of the tests each year. The researchers have developed a model called *mean + N(s. d.)* or N-Method to predict the minimum score for the COTMES faculties. The results show that the error means of the years 2021, 2022, and 2023 for all majors range from between -0.7645 and +1.4505, where an error mean < 0 refers to the predicted minimum score being less than the real minimum score, and an error mean > 0 refers to the predicted minimum score being more than the real minimum score. For the Faculty of Medicine only, the error means range between -0.6477 and +1.9227. In similarity to the Faculty of Medicine, the error means for the Faculty of Dentistry range between -0.5388 and +1.2261. For the Faculty of Veterinary Medicine and the Faculty of Pharmacy, the error means range from -2.8003 to +3.3976 and 4.0377 to 4.7310, respectively.

Keywords: Admission; COTMES; Minimum score prediction; N-Method; TCAS

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Introduction

All high school students in Thailand can apply for up to 10 majors through the TCAS. After processing, the student will qualify for only one major or be disqualified. For this reason, the selection of 10 majors in the TCAS application is important and must be done with careful planning. Each student only knows their total score, not the minimum score enabling them to qualify for their major of interest. COTMES faculties consist of the Faculties of Medicine, Dentistry, Veterinary Medicine, and Pharmacy, all of which are popular and highly competitive. Therefore, the selection of 10 majors for TCAS application becomes even more important. The prediction model called $mean + N(s. d.)$ or N-Method, first represented in ISRIF2023 (Ruethaichanok *et al.*, 2023), is used to find the predicted minimum score for all COTMES faculties in this project.

When 12th-grade students take their TCAS examinations, their scores will be declared one month after the test. The official declaration takes place around the middle of April each year. Students have about two weeks to decide on their choice of majors when applying to the TCAS. The minimum score of each major is usually predicted using the minimum score of the previous year plus or minus one digit, such as +2%, -3%, or +8%. This is not an effective method since no one knows what number to add or subtract. Therefore, the use of the $mean + N(s. d.)$ model is a better choice for minimum score prediction.

Better prediction ability can help all students make the appropriate choice when deciding on a COTMES faculty and improve the efficiency of the process. They are then more likely to qualify for the admission round in TCAS.

Material and methods

This prediction method is easy to understand. For example, data in 2022 will be used to predict the minimum score in 2023. Starting with 2022 data on the major of interest, usually announced by the TCAS. The score criteria of COTMES faculties (COTMES, 2024) are shown in Figure 1. The basic statistics of all test subjects for 2022 and 2023 are shown in Figures 2 (Dek-D, 2024 and CUPT, 2022) and Figures 3 (Dek-D, 2024 and Facebook, 2024), respectively. The example results of the minimum score needed to qualify for some majors in 2022 are shown in Figure 4 (Smart Math Pro, 2024).

COTMES Score Criteria			
A-LEVEL 70%		TPAT1 30%	
English	14%	Intelligence	10%
Mathematics1	14%	Connection	10%
Science (Physics Chemistry Biology)	28%	Ethics	10%
Thai	7%		
Social Study	7%		

*All subjects have a full score of 100 points and must be scored at least 30 points

Figure 1. The score criteria of COTMES faculties in 2022

From Figure 1, the total scores of any COTMES faculties can be written as follows.

$$\begin{aligned} \text{Total score} = & 30\% \text{ of TPAT1} + 14\% \text{ of Eng} \\ & + 14\% \text{ of Math1} + 28\% \text{ of Sci} \\ & + 7\% \text{ of Thai} + 7\% \text{ of Soc} \end{aligned}$$

Where;

TPAT1= average score for Intelligence, Connection, and Ethics

Math1 = score for Mathematics1

Sci = average score for Physics, Chemistry, and Biology

Thai = score for Thai

Soc = score for Social Study

CONSORTIUM OF THAI MEDICAL SCHOOLS

Basic statistics of Medical Aptitude Test year 2022

Score	Part 1 Total 100	Part 2 Total 100	Part 3 Total 100	Total 300
Max	88.8889	68.3333	100.0000	240.7937
Min	0.0000	0.0000	0.0000	0.0000
Mean	36.5702	37.2193	72.8718	146.6081
S.D.	10.4248	7.3393	23.8968	33.2555

Dek-U

Basic statistics of GAT/PAT and general subject year 2022 (edit on 30 April 2022)										
Code	Subject	Total	Number of examinees	Mean	Standard deviation (S.D.)	Min	Max	Mode	Median	Pearson
05	General Aptitude Test	300,000	140,902	122.307	42.121	5.000	266.176	32.500	126.912	0.305
	GAT (1)	150,000	140,902	78.746	35.112	0.000	150.000	31.704	86.047	-0.999
	GAT (2)	150,000	140,902	43.561	36.974	0.000	147.500	37.500	40.000	0.342
71	Mathematics	300,000	108,987	61.140	35.500	0.000	300.000	42.000	54.000	0.542
72	Science	300,000	83,519	94.544	33.959	0.000	300.000	85.000	90.000	0.428
73	Engineering	300,000	21,519	94.007	28.000	26.000	263.000	85.000	88.000	0.824
74	Architecture	300,000	3,789	107.247	42.000	5.000	263.000	78.000	102.000	0.744
75	Teaching Profession	300,000	36,087	117.902	27.877	30.000	237.500	110.000	117.500	0.283
76	Fine Arts	300,000	4,871	114.752	34.111	42.500	216.000	111.000	114.000	0.891
77	French	300,000	2,104	110.847	34.540	30.000	300.000	78.000	90.000	0.538
78	German	300,000	803	112.340	33.999	42.000	281.000	96.000	93.000	0.435
79	Japanese	300,000	3,472	109.133	40.000	24.000	300.000	81.000	100.000	0.784
80	Chinese	300,000	7,470	108.243	50.007	30.000	300.000	84.000	90.000	0.483
81	Arabic	300,000	203	123.610	44.000	39.000	252.000	78.000	99.000	0.992
82	Italian	300,000	2,363	83.902	23.000	30.000	240.000	72.000	81.000	0.571
83	Korean	300,000	3,770	115.816	34.768	36.000	297.000	81.000	93.000	0.636
84	Thai	150,000	137,715	88.746	10.504	2.000	82.000	55.000	10.000	-0.119
85	Social Study	150,000	125,503	39.502	10.940	6.000	82.000	40.000	40.000	-0.096
86	English	150,000	138,889	25.333	10.189	1.250	86.250	23.750	30.000	0.027
87	Math1	150,000	86,764	22.427	10.475	0.000	100.000	15.000	10.000	0.003
88	Physics	150,000	73,524	22.897	12.010	0.000	100.000	15.000	20.000	0.056
89	Chemistry	150,000	72,190	19.408	9.499	0.000	98.000	16.000	10.000	0.372
90	Biology	150,000	74,190	28.914	11.252	0.000	96.000	24.000	26.000	0.438
91	Math2	150,000	14,888	23.874	10.357	0.000	100.000	18.000	21.000	0.443
92	General Science	150,000	20,667	26.340	9.746	0.000	81.250	21.875	25.000	0.481

*PAT (Practical Aptitude Test)

Figure 2. The basic statistics of the Medical Aptitude Test and A-levels in the year 2022

Basic statistics of the test subjects TCAS 66

A-Level year 2023

Subject	Full Score	Number of examinees	Mean	Median	Mode	Standard deviation (SD)	Min	Max
A-Level Math 1	100	126958	18.403	15	15	11.57	0	100
A-Level Math 2	100	86470	32.142	26	15	18.038	0	100
A-Level Science	100	57740	33.754	32.9	29.8	11.65	21	98.9
A-Level Physics	100	86782	21.821	21	18	10.909	0	100
A-Level Chemistry	100	89568	18.403	17.5	15	9.349	0	100
A-Level Biology	100	88477	32.781	32.4	27.2	13.058	2	100
A-Level Social Study	100	145081	41.985	42	42	10.074	0	84
A-Level Thai	100	148104	56.439	58	62	11.797	0	88
A-Level English	100	164127	46.009	43.75	31.25	17.134	0	100
A-Level French	100	2257	36.852	35	28	17.887	2	100
A-Level German	100	811	45.272	34	34	16.875	10	100
A-Level Japanese	100	3833	59.004	34	28	17.686	0	100
A-Level Korean	100	4009	37.422	34	35	16.214	10	86
A-Level Chinese	100	7929	34.181	29.699	24	16.921	0	98
A-Level Psk	100	148	39.817	35	28	13.014	14	78
A-Level Spanish	100	822	36.828	32	28	15.448	10	84

Formula for calculating the T-score of A-Level scores
 $T = 60 + 5.727190 \times \frac{\text{mean}/\text{SD}}$

Information on 17 Apr. 2023

Figure 3. The basic statistics of TPAT1 and A-levels in the year 2023

* NOTE: The Medical Aptitude Test in the year 2022 and the TPAT1 in the year 2023 relate to the same subjects



Max, Min and Mean of Medical Aptitude Test of each University in COTMES year 2022

Code	Faculty/University	Max	Min	Mean
5031011100101A	Faculty of Medicine, Khon Kaen University	63.5734	63.1882	62.2878
50310102100101A	Faculty of Medicine, Chulalongkorn University	62.4161	68.8165	72.1287
50310103100101A	Faculty of Medicine, Chulalongkorn University - Department of Medical Sciences, Royal Thai Air Force	70.1189	63.0429	63.9236
50310104100101A	Faculty of Medicine, Chiang Mai University	66.0644	59.6330	61.2002
50310105100101A	Faculty of Medicine, Thammasat University	67.1829	61.1510	62.3395
50310106100101A	Faculty of Medicine, Naresuan University	59.2640	57.0482	57.6570
50310107100101A	Faculty of Medicine Ramathubol Hospital, Mahidol University	77.0199	64.6594	67.7316
50310108100101A	Faculty of Medicine Siriraj Hospital, Mahidol University	62.2928	63.3300	67.5444
50310109100101A	College of Medicine, Rangsit University (Department of Hospital Clinical Medicine)	56.1661	54.1581	55.4139
50310110100101A	College of Medicine, Rangsit University (Srinakharinwirot Hospital Clinical Medicine)	54.2123	53.4037	53.7610
50310111100101A	College of Medicine, Rangsit University (Department of Hospital Clinical Medicine)	55.1456	53.0308	53.4301
50310112100101A	Faculty of Medicine, Srinakharinwirot University	61.7991	58.1708	59.3002
50310113100101A	Faculty of Medicine, Prince of Songkla University	62.6216	57.2649	58.3184

Figure 4. Example of the minimum score for each major after TCAS processing in the year 2022

Focusing on the data for 2022, the second step is to find the value of N that makes the total score for the major of interest equal to the “real” official minimum score announced by the TCAS.

For example, the minimum score for the Faculty of Medicine at Chulalongkorn University in 2022 is 66.8185 (yellow highlight in Figure 4).

Since the $TPAT1$ in 2023 and the Medical Aptitude Test (Med) in 2022 relate to the same subjects, the $TPAT1$ of Equation (1) in 2022 can be written as follows:

$$TPAT1 = \text{mean}(Med) + (N \times s.d.(Med))$$

The same applies to other subjects, as shown in the following equations:

$$Math1 = \text{mean}(Math1) + (N \times s.d.(Math1))$$

$$Eng = \text{mean}(Eng) + (N \times s.d.(Eng))$$

$$Sci = \text{mean}(Sci) + (N \times s.d.(Sci))$$

$$Thai = \text{mean}(Thai) + (N \times s.d.(Thai))$$

$$Soc = \text{mean}(Soc) + (N \times s.d.(Soc))$$

Remark: The mean and standard deviation (s.d.) of each subject are shown in Figure 2. The value of N must not result in the score exceeding the maximum score in each year.

Next step, the value of N that makes the total score equal to the real minimum score announced by the TCAS is identified. The researchers use Excel in Microsoft Office to find the value of N . For the Faculty of Medicine Chulalongkorn University, in this example, the value of N is 2.727190. This value of N makes the total score equal to 66.8185.

The last step to finding the predicted minimum score for 2023 is to use $N = 2.727190$ with 2023 subjects and perform the same calculation. The total score determined is the predicted minimum score for 2023.

$$TPAT1 = \frac{143.434100}{3} + 2.727190 \times \frac{41.690000}{3} = 85.710217$$

$$Eng = 46.009000 + 2.727190 \times 17.134000 = 92.736673$$

$$Math1 = 19.407000 + 2.727190 \times 11.370000 = 50.415150$$

$$Physics = 21.821000 + 2.727190 \times 10.909000 = 51.571916$$

$$Chemistry = 18.403000 + 2.727190 \times 9.349000 = 43.899499$$

$$Biology = 32.781000 + 2.727190 \times 13.058000 = 68.392647$$

$$Sci = \frac{\text{average for Physics, Chemistry and Biology}}{3} = \frac{51.571916 + 43.899499 + 68.392647}{3} = 54.621354$$

$$Thai = 56.439000 + 2.727190 \times 11.797000 = 88.611660$$

$$Soc = 41.595000 + 2.727190 \times 10.074000 = 69.068712$$

$$\begin{aligned} \text{Total score} &= 0.30 \times 85.710217 \\ &+ 0.14 \times 92.736673 \\ &+ 0.14 \times 50.415150 \\ &+ 0.28 \times 54.621354 \\ &+ 0.07 \times 88.611660 \\ &+ 0.07 \times 69.068712 \\ &= 72.085925 \\ &= \text{Predicted minimum score} \end{aligned}$$

From this computation, the predicted minimum score of the Faculty of Medicine at Chulalongkorn University in 2023 is 72.085925. The real minimum score of this major is 72.8402, so the error of prediction is

$$\begin{aligned} \text{Prediction} \quad \text{Real score} \\ 72.085925 - 72.8402 &= -0.754275 \quad \underbrace{(-1.0356\%)}_{\frac{-0.754275}{72.8402} \times 100} \end{aligned}$$

The procedure for the minimum score prediction using the N-Method model is concluded in Figure 5.

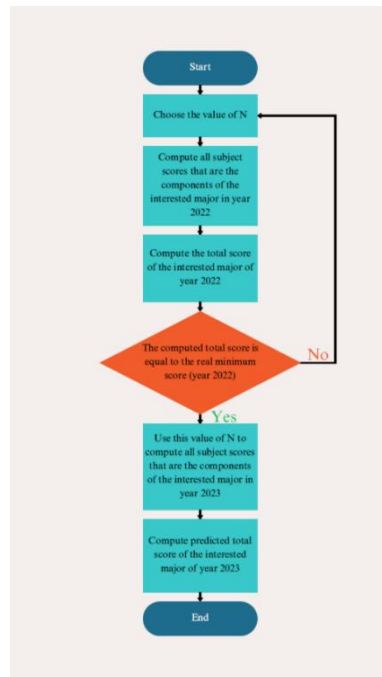


Figure 5. Procedure for the minimum score prediction of the N-method model

Results and Discussion

The number of majors in COTMES each year differs. For example, there were 55 majors in 2021, 58 in 2022 and 59 in 2023. The results of the predicted minimum score, real minimum score, and error of COTMES faculties for the years 2021, 2022, and 2023 are shown in Figure 6.

The prediction efficiency, represented in the mean, s.d., min, and max of the errors, is shown in Table 2. The prediction efficiency in the Faculties of Medicine, Dentistry, Veterinary Medicine, and Pharmacy is also shown in Figure 7.

The results clearly show that the N-Method can be used to predict the minimum score of COTMES faculties with an error mean of between -0.7645 and +1.4505. An error mean < 0 refers to the predicted minimum score being less than the real minimum score, while an error mean > 0 refers to the predicted minimum score being more than the real minimum score. In 2021, the Faculty of Veterinary Science, RMUTSV had a minimum error

[illegible]

Figure 6. Predicted minimum score, real minimum score, and error of COTMES faculties for the years 2021, 2022, and 2023

		2021	2022	2023
Total	mean	1.4505	-0.0333	-0.7645
	sd	3.5290	3.9288	2.1029
	min	-4.6338	-10.7825	-6.4623
	max	13.6459	9.7864	9.2743
Faculty of Medicine	mean	-0.6477	1.9227	-0.2101
	sd	0.7577	0.6156	0.8646
	min	-1.9369	1.1976	-1.3318
	max	0.4764	3.8354	2.7569
Faculty of Dentistry	mean	-0.5388	1.2261	0.0650
	sd	0.9108	0.4474	3.4530
	min	-2.4705	0.6736	-5.6761
	max	0.3201	2.1717	9.2743
Faculty of Veterinary Medicine	mean	3.3976	-1.9734	-2.8003
	sd	3.8527	4.3859	2.2540
	min	-4.6338	-10.1112	-6.4623
	max	10.6641	5.2969	-0.5823
Faculty of Pharmacy	mean	4.7310	-4.0377	-0.8840
	sd	3.9927	3.9021	0.7190
	min	0.8582	-10.7825	-1.9024
	max	13.6459	0.7889	0.8925

Figure 7. The basic statistics of the prediction error from 2021–2023

of -4.6338. The Faculty of Pharmacy (Pharmaceutical Care Program), SWU, had a maximum error of +13.6459. In 2022, the Faculty of Pharmacy (Pharmaceutical Care Program), SWU, had a minimum error of -10.7825, while the College of Dental Medicine, RSU, had a maximum error of +9.7864. In 2023, the minimum error (-6.4623) occurred at the Faculty of Veterinary Medicine, MUT, while the maximum error (+9.2743) occurred at the Faculty of Dentistry, NTU. When considering the efficiency of the model, the Faculty of Medicine and Faculty of Dentistry have acceptable error means. On the contrary, the Faculty of Veterinary Medicine and the Faculty of Pharmacy still have unsatisfactory results.

The error intervals and the number of majors in 2021, 2022, and 2023 (the error distribution) are shown in Figures 8, 9, and 10, respectively.

2021				
Error interval	Number of majors	Number of major accumulation	%	% Accumulation
greater or equal 10.0000	2	2	3.6364	3.6364
from 9.0000 and 9.9999	1	3	1.8182	5.4545
from 8.0000 and 8.9999	2	5	3.6364	9.0909
from 7.0000 and 7.9999		5	0.0000	9.0909
from 6.0000 and 6.9999	1	6	1.8182	10.9091
from 5.0000 and 5.9999	1	7	1.8182	12.7273
from 4.0000 and 4.9999	3	10	5.4545	18.1818
from 3.0000 and 3.9999	2	12	3.6364	21.8182
from 2.0000 and 2.9999	2	14	3.6364	25.4545
from 1.0000 and 1.9999	5	19	9.0909	34.5455
from 0.0000 and 0.9999	10	29	18.1818	52.7273
from -0.9999 to 0.0000	14	43	25.4545	78.1818
from -1.9999 to -1.0000	8	51	14.5455	92.7273
from -2.9999 to -2.0000	1	52	1.8182	94.5455
from -3.9999 to -3.0000	2	54	3.6364	98.1818
from -4.9999 to -4.0000	1	55	1.8182	100.0000
from -5.9999 to -5.0000		55	0.0000	100.0000
from -6.9999 to -6.0000		55	0.0000	100.0000
from -7.9999 to -7.0000		55	0.0000	100.0000
from -8.9999 to -8.0000		55	0.0000	100.0000
from -9.9999 to -9.0000		55	0.0000	100.0000
smaller or equal -10.0000		55	0.0000	100.0000
Total	55		100.0000	

Figure 8. The error distribution for 2021

2022				
Error interval	Number of majors	Number of major accumulation	%	% Accumulation
greater or equal 10.0000		0	0.0000	0.0000
from 9.0000 and 9.9999	1	1	1.7241	1.7241
from 8.0000 and 8.9999		1	0.0000	1.7241
from 7.0000 and 7.9999		1	0.0000	1.7241
from 6.0000 and 6.9999		1	0.0000	1.7241
from 5.0000 and 5.9999	2	3	3.4483	5.1724
from 4.0000 and 4.9999	2	5	3.4483	8.6207
from 3.0000 and 3.9999	1	6	1.7241	10.3448
from 2.0000 and 2.9999	8	14	13.7931	24.1379
from 1.0000 and 1.9999	18	32	31.0345	55.1724
from 0.0000 and 0.9999	7	39	12.0690	67.2414
from -0.9999 to 0.0000	2	41	3.4483	70.6897
from -1.9999 to -1.0000	1	42	1.7241	72.4138
from -2.9999 to -2.0000	5	47	8.6207	81.0345
from -3.9999 to -3.0000	3	50	5.1724	86.2069
from -4.9999 to -4.0000	1	51	1.7241	87.9310
from -5.9999 to -5.0000	2	53	3.4483	91.3793
from -6.9999 to -6.0000	1	54	1.7241	93.1034
from -7.9999 to -7.0000		54	0.0000	93.1034
from -8.9999 to -8.0000	1	55	1.7241	94.8276
from -9.9999 to -9.0000	1	56	1.7241	96.5517
smaller or equal -10.0000	2	58	3.4483	100.0000
Total	58		100.0000	

Figure 9. The error distribution for 2022

2023				
Error interval	Number of majors	Number of major accumulation	%	% Accumulation
greater or equal 10.0000		0	0.0000	0.0000
from 9.0000 and 9.9999	1	1	1.6949	1.6949
from 8.0000 and 8.9999		1	0.0000	1.6949
from 7.0000 and 7.9999		1	0.0000	1.6949
from 6.0000 and 6.9999		1	0.0000	1.6949
from 5.0000 and 5.9999	1	1	0.0000	1.6949
from 4.0000 and 4.9999		1	0.0000	1.6949
from 3.0000 and 3.9999		1	0.0000	1.6949
from 2.0000 and 2.9999	2	3	3.3898	5.0847
from 1.0000 and 1.9999	1	4	1.6949	6.7797
from 0.0000 and 0.9999	5	9	8.4746	15.2542
from -0.9999 to 0.0000	30	39	50.8475	66.1017
from -1.9999 to -1.0000	15	54	25.4237	91.5254
from -2.9999 to -2.0000	1	55	1.6949	93.2203
from -3.9999 to -3.0000		55	0.0000	93.2203
from -4.9999 to -4.0000		55	0.0000	93.2203
from -5.9999 to -5.0000	2	57	3.3898	96.6102
from -6.9999 to -6.0000	2	59	3.3898	100.0000
from -7.9999 to -7.0000		59	0.0000	100.0000
from -8.9999 to -8.0000		59	0.0000	100.0000
from -9.9999 to -9.0000		59	0.0000	100.0000
smaller or equal -10.0000		59	0.0000	100.0000
Total	59		100.0000	

Figure 10. The error distribution for 2023

From Figure 8-10, it can be clearly observed that most majors are in the -2.9999 and +2.9999 error range (highlighted in blue). In 2021, 39 out of the 55 majors were within this error range. In 2022, 41 out of the 58 majors were within this error range. The best performance occurred in 2023, with 54 out of the 59 majors being in the -2.9999 and +2.9999 error range.

When the maximum error, not exceeding -4.9999 (highlighted in green), is considered, all 55 majors fall into this category in 2021. However, in 2022, there were 51 out of the 58 majors where the error did not exceed -4.9999. In 2023, the error for 55 out of the 59 majors did not exceed -4.9999.

Conclusion

The *mean* + *N(s. d.)* model or N-Method was used in this study to predict the scores of all majors in COTMES for the years 2021–2023. The predictions using the N-Method were found to work well for the Faculty of Medicine and the Faculty of Dentistry. The Faculty of Veterinary Medicine and the Faculty of Pharmacy exhibited more fluctuations, leading to a less accurate predicted score compared to the previous two. Therefore, alternative data processing may be used to reduce prediction errors and improve the performance of the next project, which will focus on the results for 2024.

Suggestion

The average of N for two consecutive years should be used to improve prediction accuracy and reduce prediction fluctuations. The researchers suggest developing a program to calculate the value of N for each major in the future.

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