

MVAT 2000 – statistical report

This report contains summary tables and some statistical analyses of candidate performance on the Cambridge University Medical and Veterinary Admissions Test (MVAT) taken in November 2000.

The test was in three sections – sections A and B consisted of objectively marked short-answer or multiple-choice questions. In section C candidates had a choice of 2 from 12 essays, provided the essays were in different subject areas. There were four subject areas (Biology, Chemistry, Physics, Mathematics), each containing three essay questions.

Table 1: Summary statistics for sections A and B

	N	Minimum	Maximum	Mean	Std. Deviation
Section A (out of 21)	1506	0	21	10.6	3.6
Section B (out of 39)	1506	1	38	25.1	6.4

Table 2: Summary statistics for each question in section C

	N	Minimum	Maximum	Mean	Std. Deviation	Mean A*	S.D. A	Mean B	S.D. B
CHE_Q1	290	1	9	4.9	1.4	10.9	3.7	25.4	6.5
CHE_Q2	322	1	9	5.3	1.3	10.5	3.4	24.6	6.5
CHE_Q3	537	1	10	5.0	1.2	10.4	3.5	25.5	5.8
BIO_Q4	704	1	8	5.2	1.1	10.3	3.4	25.8	5.3
BIO_Q5	187	1	9	4.7	2.0	10.4	3.7	23.8	8.0
BIO_Q6	316	1	9	5.2	1.2	10.2	3.7	24.6	6.7
PHY_Q7	146	1	8	4.7	1.4	11.7	3.7	25.3	6.7
PHY_Q8	212	2	8	5.3	1.1	11.0	3.7	26.7	6.1
PHY_Q9	71	1	7	4.8	1.0	10.7	3.3	26.2	5.2
MTH_Q10	174	2	8	5.5	1.2	10.8	3.7	21.5	7.4
MTH_Q11	15	3	7	5.5	1.4	13.5	4.6	24.3	8.1
MTH_Q12	24	3	7	4.7	1.0	11.5	3.9	24.5	7.8

N.B. Each candidate did two section C questions

*These last four columns give the mean and standard deviation of scores on sections A and B for the candidates choosing each section C question. This gives a rough indication of differences in difficulty between the section C questions. For example, average scores were lower on Physics question 7 than on Biology question 6, yet the Physics Q7 candidates had scored higher on average in sections A and B than the Biology Q6 candidates.

In the following tables the summary statistics for section C should be interpreted with caution since the score 'Section C total' is the sum of the scores on the two questions attempted by each candidate in section C. There were 12 different essay questions to choose from, and a subjective element to the marking. Candidates' total scores are not therefore as directly comparable as the scores on sections A and B where all the questions were compulsory and the mark scheme was completely objective.

Table 3: Summary statistics by course and sex (crossed)

Section A		Valid N	Mean	S.D.
medicine	male	448	11.66	3.65
	female	571	10.24	3.57
veterinary	male	105	11.19	3.40
	female	365	9.58	3.21

Section B		Valid N	Mean	S.D.
medicine	male	448	26.87	6.01
	female	571	24.32	6.39
veterinary	male	105	26.50	5.96
	female	365	23.75	6.51

Section C		Valid N	Mean	S.D.
medicine	male	449	10.29	2.13
	female	574	10.27	2.06
veterinary	male	105	10.01	2.04
	female	364	9.80	2.00

The tables show the same pattern, with males performing better than females, and medical candidates performing better than veterinary candidates. However, these differences are smaller in section C than in sections A and B. The marks are noticeably less well spread out in section C than in sections A and B – the section C standard deviation is around 60% of that of section A, which had a similar mark total.

Table 4: Summary statistics by school type

	Section	A		B		C		
		Valid N	Mean	S. D.	Mean	S. D.	Mean	S. D.
UK Comprehensive		267	10.16	3.40	25.05	5.05	9.96	1.88
UK FE / 6th form college		144	9.54	3.24	25.03	5.25	10.32	1.82
UK Grammar		116	11.09	3.26	26.55	5.05	10.13	1.76
UK Independent		518	11.28	3.47	27.42	4.95	10.53	2.02
UK other maintained		126	9.97	3.26	25.73	5.96	10.15	1.97
N/A (mature student)		172	9.22	3.75	19.55	7.17	9.88	2.16
School in EU country		11	10.00	2.41	14.91	5.09	9.27	1.79
Non-EU overseas school		152	11.45	3.98	22.59	8.81	9.44	2.69
Total		1507	10.57	3.58	25.09	6.42	10.15	2.07

The performance of the overseas schools is far worse on section B than on section A. Among the UK schools, there is a similar pattern of performance on all three sections (although it is perhaps noticeable that the FE / 6th form do relatively better on section C and relatively poorly on section A. There are fewer differences between the different school types on section C. The performance of the mature students is worse than the UK school students in all three sections.

Table 5: Summary statistics by selection decision

		Section	A		B		C		
			Valid N	Mean	S. D.	Mean	S. D.	Mean	S. D.
Decision	Offer		367	12.38	3.70	29.34	4.46	11.11	1.96
	Pool - offer		49	11.88	3.30	28.24	3.87	10.90	1.86
	Pool - reject		160	11.88	3.39	27.57	4.51	10.43	1.65
	Reject		921	9.56	3.16	22.85	6.36	9.70	2.02
	Total		1497	10.58	3.57	25.12	6.39	10.16	2.06

In all three sections, the mean scores of those given an offer and those pooled were closer to each other than to the mean scores of those rejected. In section B the differences were most noticeable, in accordance with the greater spread of scores on that section.

The boxplot below shows the distribution of the aggregate of all three sections for those selected and those rejected. The 'box' contains the middle 50% of the distribution, so the plot shows that the overall test performance has either contributed heavily to (or correlated well with) the decisions of the colleges on whether to admit candidates. Of course, it should be noted that there are some candidates with very high MVAT scores who were rejected, and vice versa.

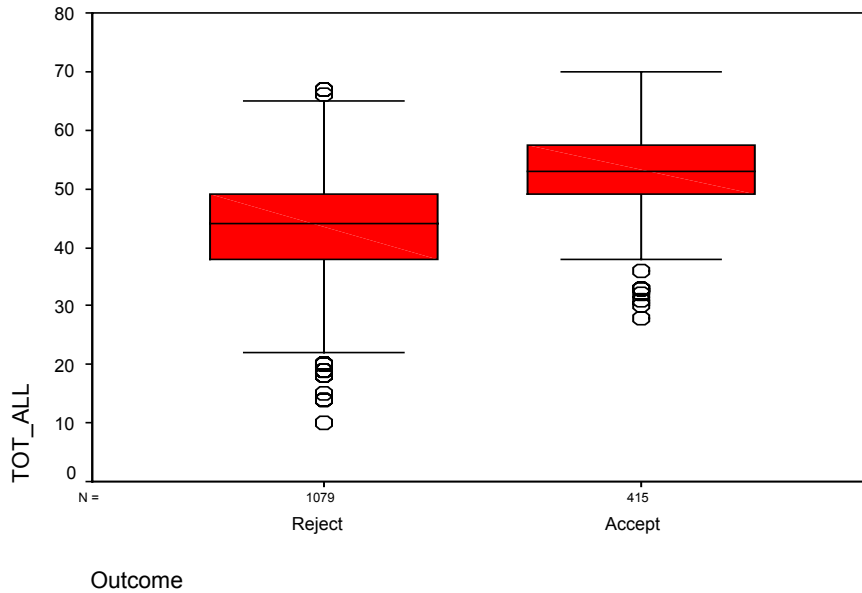


Table 6: Summary statistics by school type & outcome

	Section	A		B		C		
		Valid N	Mean	S. D.	Mean	S. D.	Mean	S. D.
UK Comprehensive	Reject	199	9.55	3.18	23.98	4.78	9.71	1.80
	Accept	67	12.04	3.36	28.40	4.17	10.70	1.93
UK FE / 6th form college	Reject	104	9.03	3.03	23.80	5.28	10.03	1.74
	Accept	40	10.88	3.44	28.25	3.56	11.08	1.83
UK Grammar	Reject	83	10.58	3.09	25.60	5.01	9.83	1.58
	Accept	33	12.39	3.37	28.94	4.36	10.88	1.98
UK Independent	Reject	332	10.46	3.17	25.86	4.89	10.06	1.91
	Accept	184	12.82	3.47	30.32	3.53	11.40	1.91
UK other maintained	Reject	96	9.45	2.93	24.57	5.72	9.96	1.84
	Accept	29	11.72	3.77	30.21	3.76	11.00	1.89
N/A (mature student)	Reject	130	8.74	3.44	17.70	6.49	9.74	2.14
	Accept	38	10.63	4.39	25.08	6.14	10.21	2.08
School in EU country	Reject	11	10.00	2.41	14.91	5.09	9.27	1.79
Non-EU overseas school	Reject	126	10.83	3.74	21.21	8.53	9.07	2.60
	Accept	24	14.79	3.15	30.13	5.57	11.54	1.86
Total		1497	10.58	3.57	25.12	6.39	10.16	2.06

All the EU candidates were rejected. The UK FE / 6th form colleges seem to have lower scores for those accepted than other UK schools in section A. The non-EU overseas candidates who were accepted had a very high mean on sections A and C.

Table 7: Correlations between the three MVAT sections and the outcome (accept / reject)

		A_TOTAL	B_TOTAL	C_TOTAL	Outcome
A_TOTAL	Pearson Correlation	1.000	.467	.197	.304
	N	1497	1496	1495	1497
B_TOTAL	Pearson Correlation	.467	1.000	.355	.396
	N	1496	1497	1494	1497
C_TOTAL	Pearson Correlation	.197	.355	1.000	.278
	N	1495	1494	1497	1497
Outcome	Pearson Correlation	.304	.396	.278	1.000
	N	1497	1497	1497	1570

Section B correlated best with the outcome. All correlations were significant. Sections A and C correlated better with the outcome (accept or reject) than they did with each other. This suggests that all three sections were contributing something different to the selection decision.

Selection decision by demographics

The following tables show the 2-way classification of selection decision with gender (male/female), nationality (UK / overseas) and, for the UK candidates only, school sector (independent / the rest). The overseas candidates were identified as those who either had come from an EU or overseas school type, or who were directly identified as EU or overseas in the data set (the two columns did not give exactly the same information, because some of the mature students were from overseas).

These tables basically address the question of whether candidates identified by these groupings were selected in the proportion that they applied – as indicated by the ‘expected count’ in each cell.

Table 8: Cross-tabulation of gender and outcome

			Outcome	
			Reject	Accept
Gender	Males	Count	417	163
		Expected Count	422.1	157.9
	Females	Count	714	260
		Expected Count	708.9	265.1

The expected frequencies were very similar to the observed – the chi-square test was not close to significance ($p=0.55$). This shows that males and females were accepted in the proportion that they applied.

Table 9: Cross-tabulation of nationality and outcome

			Outcome	
			Reject	Accept
Overseas	UK	Count	915	387
		Expected Count	948.7	353.3
	Overseas	Count	229	39
		Expected Count	195.3	72.7

More UK candidates and fewer overseas candidates were accepted than expected from the relative proportions applying. The chi-square test was highly significant ($p=0.00$).

Table 10: Cross-tabulation of School sector and outcome (UK candidates only)

Sector			Outcome	
			Reject	Accept
Not independent	Count	603	206	
	Expected Count	568.5	240.5	
Independent	Count	312	181	
	Expected Count	346.5	146.5	

More candidates from the independent sector and fewer from the other sectors were accepted than expected from the relative proportions applying. The chi-square test was highly significant ($p=0$).

Fitting a model to selection decision

The above tables only compare the proportions accepted to the proportions applying. A more relevant analysis is to allow for the effect of performance on the MVAT – i.e. to attempt to answer the question ‘Are males / females with equivalent MVAT scores equally likely to be accepted?’ This question can be addressed by fitting a logistic regression model.

The dependent variable is the binary outcome (accept or reject). The independent continuous variables are the scores on the three sections of the MVAT (remembering that the section C score is a somewhat suspect composite). The independent categorical variables are the demographics (gender, nationality, school sector).

Model 1: Nationality and gender (all candidates)

The model fitted was

$$\log \text{ odds (accept)} = \alpha + \beta_1 (\text{sec A}) + \beta_2 (\text{sec B}) + \beta_3 (\text{sec C}) + \beta_4 (\text{male}) + \beta_5 (\text{UK}) + \text{error}$$

Table 11: Results of fitting model 1

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	A_TOTAL	.130	.022	35.468	1	.000	1.138
	B_TOTAL	.167	.016	105.674	1	.000	1.182
	C_TOTAL	.240	.038	40.358	1	.000	1.271
	MALE(1)	-.551	.144	14.609	1	.000	.577
	UK(1)	1.092	.235	21.516	1	.000	2.980
	Constant	-10.161	.655	240.873	1	.000	.000

The B parameters show the size and direction of the effect of each variable. All parameters are significantly different from zero. The three MVAT sections have positive parameters, as would be hoped. Section C has the largest parameter, but this is because the marks were less spread out on section C and each mark was therefore ‘worth’ more.

The parameters for gender and overseas are interesting. Males of equivalent MVAT score are less likely to be accepted than females. The size of this effect can be seen from the final column, which gives the exponent of the B parameter. This is the effect on the odds of success. Males have odds that are 0.58 of those of females with the same MVAT score.

The effect of nationality is even more significant – UK candidates are nearly 3 times as likely to be accepted as overseas candidates with equivalent MVAT scores.

Model 2: School sector and gender (UK candidates only)

The model fitted was

$$\log \text{ odds (accept)} = \alpha + \beta_1 (\text{sec A}) + \beta_2 (\text{sec B}) + \beta_3 (\text{sec C}) + \beta_4 (\text{male}) + \beta_5 (\text{UK non-indep}) + \text{error}$$

Table 12: Results of fitting model 2

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	A_TOTAL	.126	.023	30.234	1	.000	1.135
	B_TOTAL	.176	.018	98.433	1	.000	1.192
	C_TOTAL	.231	.040	33.214	1	.000	1.260
	MALE(1)	-.617	.152	16.429	1	.000	.539
	NON-INDEP(1)	.000	.145	.000	1	.998	1.000
	Constant	-9.146	.659	192.365	1	.000	.000

The results for the three sections of the test and gender are very similar to model 1 – showing that males of equivalent school background and MVAT score are less likely to be accepted than females. However, the parameter for school sector is exactly zero – showing no effect at all on likelihood of acceptance.

N.B.

Care should be taken not to over-interpret these results, for example to say that the admissions process is biased against males. There are other factors not included in this statistical model which one might expect to influence the admissions decision, such as performance at interview, GCSE results, predicted A-Level grades, and school report. However, it does provide some more concrete evidence than a simple comparison of proportions applying and proportions accepted.