CONTINGENCY TABLES

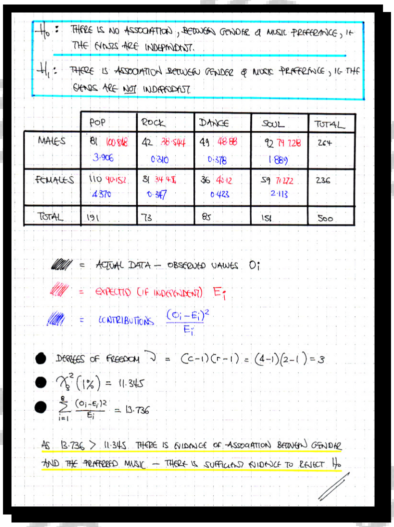
Question 1 (**)

The music preferences of 500 individuals are summarized in the table below.

	Pop	Rock	Dance	Soul
Males	81	42	49	92
Females	110	31	36	59

Use a χ^2 test, at the 1% level of significance, to investigate whether there is any association between the gender and the preferred music.

$\boxed{}$, $\boxed{\text{association, } 13.736 > 11.345}$



H_0: THERE IS NO ASSOCIATION, BETWEEN GENDER & MUSIC PREFERENCE, IE THE EVENTS ARE INDEPENDENT.

H_1: THERE IS ASSOCIATION BETWEEN GENDER & MUSIC PREFERENCE, IE THE EVENTS ARE NOT INDEPENDENT.

	POP	ROCK	DANCE	SOUL	TOTAL
MALES	81 100.848 3.906	42 38.544 0.310	49 44.88 0.378	92 79.728 1.889	264
FEMALES	110 90.152 4.370	31 34.456 0.347	36 40.12 0.423	59 71.272 2.113	236
TOTAL	191	73	85	151	500

= ACTUAL DATA – OBSERVED VALUES O_i

= EXPECTED (IF INDEPENDENT) E_i

= CONTRIBUTIONS $\frac{(O_i - E_i)^2}{E_i}$

- DEGREES OF FREEDOM $\nu = (c-1)(r-1) = (4-1)(2-1) = 3$
- $\chi_3^2(1\%) = 11.345$
- $\sum_{i=1}^{8} \frac{(O_i - E_i)^2}{E_i} = 13.736$

AS $13.736 > 11.345$ THERE IS EVIDENCE OF ASSOCIATION BETWEEN GENDER AND THE PREFERRED MUSIC – THERE IS SUFFICIENT EVIDENCE TO REJECT H_0

Question 2 (**)

A cinema manager believes that there is an association between the gender of his customers and the type of film they come to watch. The table below shows 1000 viewers in this cinema classified by gender and by the type of film they watched.

	Action Film	Comedy Film	Romance Film
Male	239	185	140
Female	155	150	131

Use a χ^2 test, at the 5% level of significance, to investigate whether there is evidence to support the manager's claim.

[illegible], $\boxed{\text{no association, } 5.571 < 5.991}$

SETTING HYPOTHESES

H_0: THERE IS NO ASSOCIATION BETWEEN GENDER & FILM TYPE PREFERENCE, IE THE EVENTS ARE INDEPENDENT

H_1: THERE IS ASSOCIATION BETWEEN GENDER & FILM PREFERENCE, IE THE EVENTS ARE NOT INDEPENDENT

SETTING A MULTIPURPOSE TABLE

	ACTION FILM	COMEDY FILM	ROMANCE FILM	TOTAL
MALE	239 222.216 1.267	185 188.94 0.082	140 152.844 1.079	564
FEMALE	155 171.784 1.640	150 146.06 0.106	131 118.156 1.396	436
TOTAL	394	335	271	1000

= ACTUAL DATA – OBSERVED FREQUENCY O_i

= EXPECTED FREQUENCY E_i (IF INDEPENDENT)

= CONTRIBUTIONS $\frac{(O_i-E_i)^2}{E_i}$

SUMMARIZING THE REST OF THE AUXILIARIES

- DEGREES OF FREEDOM $\nu = (r-1)(c-1) = (2-1)(3-1) = 2$
- $\chi_2^2(5\%) = 5.991$
- $\sum_{i=1}^{6} \frac{(O_i-E_i)^2}{E_i} = 5.570$

AS $5.570 < 5.991$ THERE IS EVIDENCE OF INDEPENDENCE, IE IT APPEARS THAT THERE IS NO ASSOCIATION BETWEEN GENDER & TYPE OF FILM – THERE IS NO SUFFICIENT EVIDENCE TO REJECT H_0

Question 3 (**)

The following table shows a random sample of 200 adults in a Café which ordered tea, coffee or chocolate, classified by gender.

	Tea	Coffee	Chocolate
Male	57	26	11
Female	42	47	17

Use a χ^2 test, at the 5% level of significance, to investigate whether there is any association between the type of drink ordered and gender.

$\boxed{}$, $\boxed{\text{association, } 8.912 > 5.991}$

H_0 : THERE IS NO ASSOCIATION BETWEEN GENDER & CHOICE OF DRINK (EVENTS ARE INDEPENDENT)

H_1 : THERE IS ASSOCIATION BETWEEN GENDER & CHOICE OF DRINK (EVENTS ARE DEPENDENT)

SETTING A MULTIPURPOSE TABLE

	TEA	COFFEE	CHOCOLATE	TOTAL
MALE	57 46.53 2.356	26 34.31 2.013	11 13.16 0.355	94
FEMALE	42 52.47 2.089	47 38.69 1.785	17 14.84 0.314	106
TOTAL	99	73	28	200

= ACTUAL DATA – OBSERVED FREQUENCIES O_i

= EXPECTED FREQUENCIES E_i, IF INDEPENDENT

= CONTRIBUTIONS, $\frac{(O_i - E_i)^2}{E_i}$

SUMMARIZING THE REST OF THE AUXILIARIES

- DEGREES OF FREEDOM $\nu = (r-1)(c-1) = (2-1)(3-1) = 1 \times 2 = 2$
- CRITICAL VALUE $\chi^2_2(5\%) = 5.991$
- $\sum_{i=1}^{6} \frac{(O_i - E_i)^2}{E_i} = 8.912$

AS $8.912 > 5.991$ THERE IS SOME EVIDENCE OF ASSOCIATION BETWEEN GENDER & CHOICE OF DRINK (DEPENDENT EVENTS)

SUFFICIENT EVIDENCE TO REJECT H_0

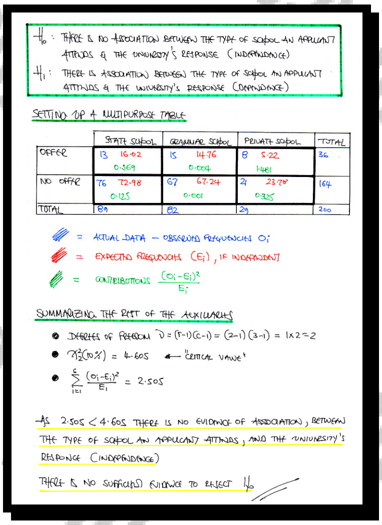
Question 4 (**)

The table below summarizes the response of the University of Dambridge to 200 prospective mathematics applicants, originating from different type of English schools.

	State School	Grammar School	Private School
Offer	13	15	8
No Offer	76	67	21

Use a χ^2 test, at the 10% level of significance, to investigate whether there is any association between the type of school the applicant attends and the response of the University of Dambridge.

$\boxed{\text{no association, } 2.505 < 4.605}$



H_0 : THERE IS NO ASSOCIATION BETWEEN THE TYPE OF SCHOOL AN APPLICANT ATTENDS & THE UNIVERSITY'S RESPONSE (INDEPENDENCE)

H_1 : THERE IS ASSOCIATION BETWEEN THE TYPE OF SCHOOL AN APPLICANT ATTENDS & THE UNIVERSITY'S RESPONSE (DEPENDENCE)

SETTING UP A MULTIPURPOSE TABLE

	STATE SCHOOL	GRAMMAR SCHOOL	PRIVATE SCHOOL	TOTAL
OFFER	13 16.02 0.569	15 14.76 0.004	8 5.22 1.481	36
NO OFFER	76 72.98 0.125	67 67.24 0.001	21 23.78 0.325	164
TOTAL	89	82	29	200

= ACTUAL DATA – OBSERVED FREQUENCIES O_i

= EXPECTED FREQUENCIES (E_i), IF INDEPENDENT

= CONTRIBUTIONS $\frac{(O_i-E_i)^2}{E_i}$

SUMMARIZING THE REST OF THE AUXILIARIES

- DEGREES OF FREEDOM $\nu = (r-1)(c-1) = (2-1)(3-1) = 1\times 2 = 2$
- $\chi^2_2(10\%) = 4.605$ ← "CRITICAL VALUE"
- $\sum_{i=1}^{6} \frac{(O_i-E_i)^2}{E_i} = 2.505$

AS $2.505 < 4.605$ THERE IS NO EVIDENCE OF ASSOCIATION, BETWEEN THE TYPE OF SCHOOL AN APPLICANT ATTENDS, AND THE UNIVERSITY'S RESPONSE (INDEPENDENCE)

THERE IS NO SUFFICIENT EVIDENCE TO REJECT H_0

Question 5 (**)

It is claimed that a new drug is effective in the prevention of sea sickness.

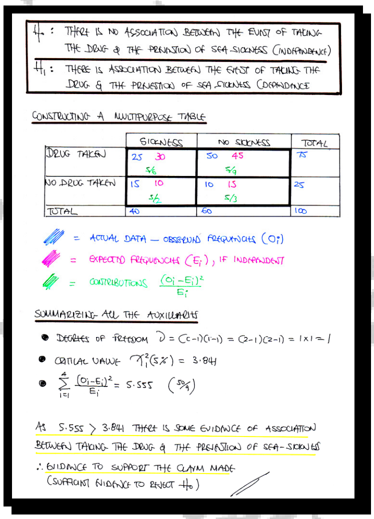
A large number of people that went on boat cruises were surveyed, and the results for a random sample of 100 individuals are summarized in the table below.

	Sickness	**No Sickness**
Drug Taken	25	50
No Drug Taken	15	10

Use a χ^2 test at the 5% level of significance to investigate whether there is evidence to support the claim made.

You may not use a Yates correction in this question.

$\boxed{}$, $\boxed{\text{claim justified, } 5.555 > 3.841}$



H_0 : THERE IS NO ASSOCIATION BETWEEN THE EVENT OF TAKING THE DRUG & THE PREVENTION OF SEA-SICKNESS (INDEPENDENCE)

H_1 : THERE IS ASSOCIATION BETWEEN THE EVENT OF TAKING THE DRUG & THE PREVENTION OF SEA-SICKNESS (DEPENDENCE)

CONSTRUCTING A MULTIPURPOSE TABLE

	SICKNESS	NO SICKNESS	TOTAL
DRUG TAKEN	25 30 5/6	50 45 5/9	75
NO DRUG TAKEN	15 10 5/2	10 15 5/3	25
TOTAL	40	60	100

= ACTUAL DATA – OBSERVED FREQUENCIES (O_i)

= EXPECTED FREQUENCIES (E_i), IF INDEPENDENT

= CONTRIBUTIONS $\frac{(O_i-E_i)^2}{E_i}$

SUMMARIZING ALL THE AUXILIARIES

- DEGREES OF FREEDOM $\nu = (c-1)(r-1) = (2-1)(2-1) = 1\times1 = 1$
- CRITICAL VALUE $\chi_1^2(5\%) = 3.841$
- $\sum_{i=1}^{4} \frac{(O_i-E_i)^2}{E_i} = 5.555 \quad \left(\frac{50}{9}\right)$

AS $5.555 > 3.841$ THERE IS SOME EVIDENCE OF ASSOCIATION BETWEEN TAKING THE DRUG & THE PREVENTION OF SEA-SICKNESS

$\therefore$ EVIDENCE TO SUPPORT THE CLAIM MADE

(SUFFICIENT EVIDENCE TO REJECT H_0)

Question 6 (***)

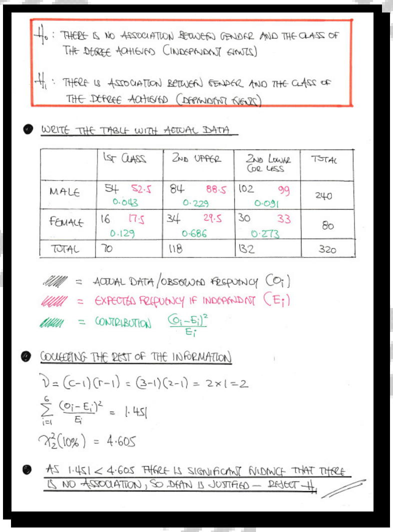
The Dean of a faculty at a London University believes that the gender is independent of the class of the degree achieved.

A random sample of 240 male students and 80 female students were examined and the **percentages for each gender** are summarized in the table below.

	First Class	**Second Upper**	**Second Lower or less**
Male	22.5%	35%	42.5%
Female	20%	42.5%	37.5%

Use a χ^2 test, at the 10% level of significance, to investigate whether there is evidence to support the Dean's claim.

[illegible], $\boxed{\text{no association, } 1.451 < 4.605}$


H_0: THERE IS NO ASSOCIATION BETWEEN GENDER AND THE CLASS OF THE DEGREE ACHIEVED (INDEPENDENT EVENTS)

H_1: THERE IS ASSOCIATION BETWEEN GENDER AND THE CLASS OF THE DEGREE ACHIEVED (DEPENDENT EVENTS)

- WRITE THE TABLE WITH ACTUAL DATA

	1ST CLASS	2ND UPPER	2ND LOWER (OR LESS	TOTAL
MALE	54 52.5 0.043	84 88.5 0.229	102 99 0.091	240
FEMALE	16 17.5 0.129	34 29.5 0.686	30 33 0.273	80
TOTAL	70	118	132	320

= ACTUAL DATA / OBSERVED FREQUENCY (O_i)
= EXPECTED FREQUENCY IF INDEPENDENT (E_i)
= CONTRIBUTION $\frac{(O_i-E_i)^2}{E_i}$

- COLLECTING THE REST OF THE INFORMATION

$\nu = (c-1)(r-1) = (3-1)(2-1) = 2\times1 = 2$

$\sum_{i=1}^{6} \frac{(O_i-E_i)^2}{E_i} = 1.451$

$\chi_2^2(10\%) = 4.605$

- AS $1.451 < 4.605$ THERE IS SIGNIFICANT EVIDENCE THAT THERE IS NO ASSOCIATION, SO DEAN IS JUSTIFIED — REJECT H_1

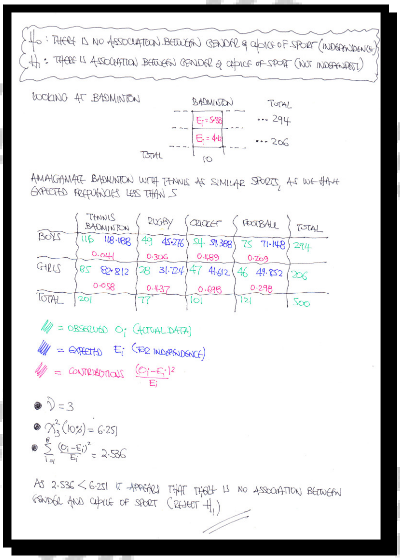
Question 7 (+)**

The activities taken by the students of a school are summarized in the table below.

	Tennis	Rugby	Cricket	Badminton	Football
Boys	111	49	54	5	75
Girls	80	28	47	5	46

Use a χ^2 test, at the 10% level of significance, to investigate whether there is any association between the gender and the sport activity taken.

$\boxed{\text{no association, } 2.536 < 6.251}$



H_0 : THERE IS NO ASSOCIATION BETWEEN GENDER & CHOICE OF SPORT (INDEPENDENCE)
H_1 : THERE IS ASSOCIATION BETWEEN GENDER & CHOICE OF SPORT (NOT INDEPENDENT)

LOOKING AT BADMINTON

	BADMINTON	TOTAL
	$E_i = 5.88$	... 294
	$E_i = 4.12$	... 206
TOTAL	10	

AMALGAMATE BADMINTON WITH TENNIS AS SIMILAR SPORTS, AS WE HAVE EXPECTED FREQUENCIES LESS THAN 5

	TENNIS BADMINTON	RUGBY	CRICKET	FOOTBALL	TOTAL
BOYS	116 118.188 0.041	49 45.276 0.306	54 59.388 0.489	75 71.148 0.209	294
GIRLS	85 82.812 0.058	28 31.724 0.437	47 41.612 0.698	46 49.852 0.298	206
TOTAL	201	77	101	121	500

= OBSERVED O_i (ACTUAL DATA)
= EXPECTED E_i (FOR INDEPENDENCE)
= CONTRIBUTIONS $\frac{(O_i - E_i)^2}{E_i}$

- $\nu = 3$
- $\chi^2_3(10\%) = 6.251$
- $\sum_{i=1}^{8} \frac{(O_i - E_i)^2}{E_i} = 2.536$

AS $2.536 < 6.251$ IT APPEARS THAT THERE IS NO ASSOCIATION BETWEEN GENDER AND CHOICE OF SPORT (REJECT H_1)

Question 8 (+)**

A new car dealership wants to investigate whether there is an association between the type of engine of car they sell, and the claims made against the warranty they offer to their cars.

The table below summarizes 200 such claims made, classified by the engine type and by the age of the car.

	Claims in year 1	Claims in year 2 or 3	Claims after year 3
Petrol Engine	10	24	128
Diesel Engine	3	6	29

Use a χ^2 test, at the 10% level of significance, to investigate whether there is such association.

You need not use the Yates correction formula if you so wish in this question.

$\boxed{}$, $\boxed{\text{no association, } 1.092 < 2.705}$

FORMING HYPOTHESES AND FORM A TABLE OF ALL AUXILIARITY

H_0: THERE IS NO ASSOCIATION BETWEEN THE TYPE OF ENGINE AND THE LIKELIHOOD OF MAKING A CLAIM (INDEPENDENT EVENTS)

H_1: THERE IS ASSOCIATION BETWEEN THE TYPE OF ENGINE AND THE LIKELIHOOD OF MAKING A CLAIM (DEPENDENT EVENTS)

	~~CLAIM IN YEAR 1~~	CLAIM IN YEAR 2/3	CLAIM IN YEAR 4+	TOTAL
PETROL ENGINE	~~10~~	~~24~~ 34 34.83 0.0198	128 127.17 0.0054	162
DIESEL ENGINE	~~3~~	~~6~~ 9 8.17 0.0843	29 24.13 0.9829	38
TOTAL	~~13~~	~~30~~ 43	157	200

: OBSERVED VALUES (ACTUAL)

: EXPECTED VALUES (IF INDEPENDENT) $\frac{\text{ROW TOTAL} \times \text{COLUMN TOTAL}}{\text{GRAND TOTAL}}$

: CONTRIBUTIONS $\frac{(O-E)^2}{E}$

LOOKING AT THE EXPECTED VALUE FOR DIESEL ENGINE CLAIMS IN YEAR 1

$$\frac{13 \times 38}{200} = 2.47 < 5$$

AMALGAMATE 1ST & 2ND ROW TO CLAIMS IN THE FIRST 3 YEARS

- $\nu = 1$
- $\chi^2_1(10\%) = 2.705$
- $\sum_{i=1}^{4} \frac{(O_i - E_i)^2}{E_i} = 1.092$

AS $1.092 < 2.705$ THERE IS EVIDENCE OF INDEPENDENCE, IE THERE IS NO ASSOCIATION BETWEEN ENGINE TYPE & LIKELIHOOD OF CLAIM – SUFFICIENT EVIDENCE TO REJECT H_1

Question 9 (**+)

A random sample of 100 pupils from 4 local schools is classified by how many grade A/A^* GCSEs were achieved last year.

	0 – 2	**3 – 5**	**6 +**
School A	4	15	6
School B	1	17	7
School C	6	15	4
School D	6	12	7

Investigate whether there is any association between the number of grade A/A^* GCSEs achieved by students and the local school attended.

Use a χ^2 test, at the 10% level of significance.

$\boxed{\text{no association, } 1.316 < 6.251}$

H_0 : THERE IS NO ASSOCIATION BETWEEN "TOP GRADES" & "THESE SCHOOLS"
H_1 : THERE IS ASSOCIATION BETWEEN "TOP GRADES" & "THESE SCHOOLS"

THE EXPECTED VALUES FOR SCHOOL A & SCHOOL B, FOR 0–2 ARE BOTH 4.25, WHICH IS LESS THAN 5
THE ONLY SENSIBLE WAY TO COMBINE IS BY AMALGAMATING THE FIRST TWO COLUMNS

	0 – 5			6+			TOTAL
A	19	0	19	6	0	6	25
B	18	1/19	19	7	1/6	6	25
C	21	4/19	19	4	2/3	6	25
D	18	1/19	19	7	1/6	6	25
TOTAL	76			24			100

$= O_i$ (OBSERVED DATA)

$= E_i$ (EXPECTED IF INDEPENDENT)

$= \dfrac{(O_i - E_i)^2}{E_i}$ (CONTRIBUTIONS)

$\nu = (4-1)\times(2-1) = 3$

$\sum_{i=1}^{8} \dfrac{(O_i-E_i)^2}{E_i} = \dfrac{25}{19} \simeq 1.316$

$\chi^2_3(10\%) = 6.251$

AS $1.316 < 6.251$ IT APPEARS THAT THERE IS NO ASSOCIATION BETWEEN TOP GRADES & THESE 4 SCHOOLS
(REJECT H_1)

Question 10 (**+)

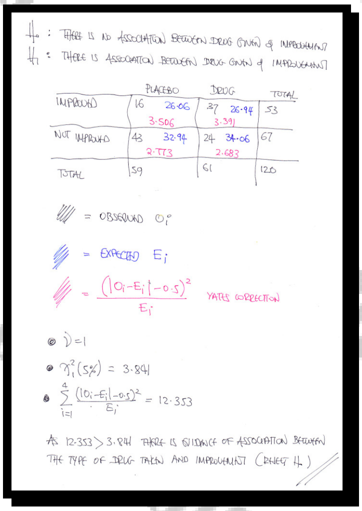
Two groups of patients took part in a clinical trial for a new drug for a certain medical condition. One of the two groups was given the drug whilst the other group was given a placebo, a "fake" drug that has no physical effect in the medical condition.

The results are summarized in the table below.

	Placebo	Drug
Condition Improved	16	37
Condition Not Improved	43	24

Use a χ^2 test at the 5% level of significance to investigate whether there is any association between the type of drug patient were given and the improvement or not in their condition.

$\boxed{\text{association, } 12.353 > 3.841}$


H_0 : THERE IS NO ASSOCIATION BETWEEN DRUG GIVEN & IMPROVEMENT
H_1 : THERE IS ASSOCIATION BETWEEN DRUG GIVEN & IMPROVEMENT

	PLACEBO	DRUG	TOTAL
IMPROVED	16 26.06 3.506	37 26.94 3.391	53
NOT IMPROVED	43 32.94 2.773	24 34.06 2.683	67
TOTAL	59	61	120

= OBSERVED O_i

= EXPECTED E_i

= $\dfrac{(|O_i - E_i| - 0.5)^2}{E_i}$ YATES CORRECTION

- $\nu = 1$
- $\chi_1^2(5\%) = 3.841$
- $\displaystyle\sum_{i=1}^{4} \frac{(|O_i - E_i| - 0.5)^2}{E_i} = 12.353$

AS $12.353 > 3.841$ THERE IS EVIDENCE OF ASSOCIATION BETWEEN THE TYPE OF DRUG TAKEN AND IMPROVEMENT (REJECT H_0)

Question 11 (**+)

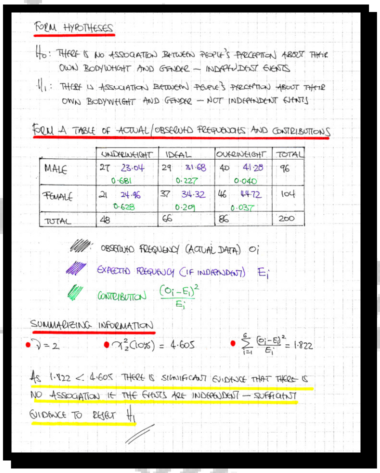
Research is carried out into the people's perception about their own bodyweight.

Subjects are being asked whether they think that they consider themselves overweight, underweight or at an ideal weight and the results are summarized in the table below.

	Underweight	**Ideal Weight**	**Overweight**
Male	27	29	40
Female	21	37	46

Investigate, using a χ^2 test, at the 10% level of significance, whether there is evidence that people's perception about their own bodyweight is independent of gender.

$\boxed{}$, $\boxed{\text{no association, } 1.822 < 4.605}$



FORM HYPOTHESES

H_0: THERE IS NO ASSOCIATION BETWEEN PEOPLE'S PERCEPTION ABOUT THEIR OWN BODYWEIGHT AND GENDER – INDEPENDENT EVENTS

H_1: THERE IS ASSOCIATION BETWEEN PEOPLE'S PERCEPTION ABOUT THEIR OWN BODYWEIGHT AND GENDER – NOT INDEPENDENT EVENTS

FORM A TABLE OF ACTUAL/OBSERVED FREQUENCIES AND CONTRIBUTIONS

	UNDERWEIGHT	IDEAL	OVERWEIGHT	TOTAL
MALE	27 23.04 0.681	29 31.68 0.227	40 41.28 0.040	96
FEMALE	21 24.96 0.628	37 34.32 0.209	46 44.72 0.037	104
TOTAL	48	66	86	200

OBSERVED FREQUENCY (ACTUAL DATA) O_i

EXPECTED FREQUENCY (IF INDEPENDENT) E_i

CONTRIBUTION $\frac{(O_i - E_i)^2}{E_i}$

SUMMARIZING INFORMATION

- $\nu = 2$
- $\chi^2_2(10\%) = 4.605$
- $\sum_{i=1}^{6} \frac{(O_i - E_i)^2}{E_i} = 1.822$

AS $1.822 < 4.605$ THERE IS SIGNIFICANT EVIDENCE THAT THERE IS NO ASSOCIATION IE THE EVENTS ARE INDEPENDENT – SUFFICIENT EVIDENCE TO REJECT H_1

Question 12 (**+)

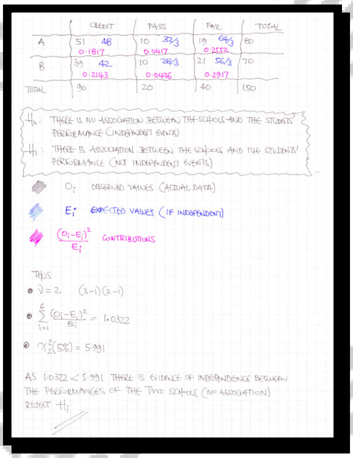
Two schools, A and B, entered their A Level mathematics for a Mathematics Competition of which three different results were possible.

These results are summarized in the table below.

	Credit	**Pass**	**Fail**
School *A*	51	10	19
School *B*	39	10	21

Use a χ^2 test, at the 5% level of significance, to investigate whether there is evidence that the proportions of these results are different between the two schools.

$\boxed{\text{no association, } 1.032 < 5.991}$



Question 13 (**+)

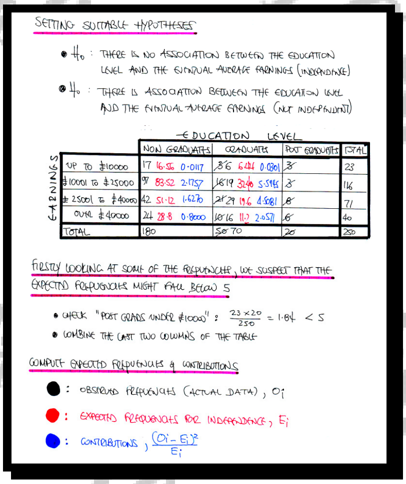
A random sample of 250 employees of a certain town were classified by their level of education and their eventual average annual earnings.

	Non Graduates	Graduates	Post Graduates
Up to £10000	17	6	3
£10001 to £25000	97	16	3
£25001 to £40000	42	21	8
Over £40000	24	10	6

Use the sample to investigate whether there is any association between level of education and the eventual average annual earnings of the employees.

Use a χ^2 test, at the 1% level of significance.

$\boxed{}$, $\boxed{\text{association, } 18.861 > 11.345}$



SETTING SUITABLE HYPOTHESES

- H_0 : THERE IS NO ASSOCIATION BETWEEN THE EDUCATION LEVEL AND THE EVENTUAL AVERAGE EARNINGS (INDEPENDENCE)
- H_1 : THERE IS ASSOCIATION BETWEEN THE EDUCATION LEVEL AND THE EVENTUAL AVERAGE EARNINGS (NOT INDEPENDENT)

EDUCATION LEVEL

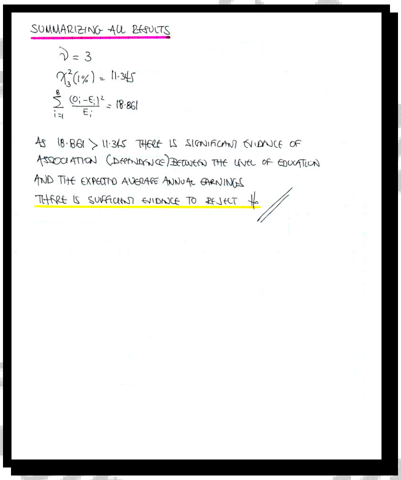
EARNINGS	NON GRADUATES	GRADUATES	POST GRADUATES	TOTAL
UP TO £10000	17 16.56 0.0117	~~6~~ 9 6.44 0.0301	~~3~~	23
£10001 TO £25000	97 83.52 2.1757	~~16~~ 19 32.48 5.5945	~~3~~	116
£25001 TO £40000	42 51.12 1.6270	~~21~~ 29 19.6 4.5081	~~8~~	71
OVER £40000	24 28.8 0.8000	~~10~~ 16 11.2 2.0571	~~6~~	40
TOTAL	180	~~50~~ 70	~~20~~	250

FIRSTLY LOOKING AT SOME OF THE FREQUENCIES, WE SUSPECT THAT THE EXPECTED FREQUENCIES MIGHT FALL BELOW 5

- CHECK "POST GRADS UNDER £10000" : $\frac{23 \times 20}{250} = 1.84 < 5$
- COMBINE THE LAST TWO COLUMNS OF THE TABLE

COMPUTE EXPECTED FREQUENCIES & CONTRIBUTIONS

- ● : OBSERVED FREQUENCIES (ACTUAL DATA), O_i
- ● : EXPECTED FREQUENCIES FOR INDEPENDENCE, E_i
- ● : CONTRIBUTIONS, $\frac{(O_i - E_i)^2}{E_i}$



SUMMARIZING ALL RESULTS

$\nu = 3$

$\chi^2_3(1\%) = 11.345$

$\sum_{i=1}^{8} \frac{(O_i - E_i)^2}{E_i} = 18.861$

AS $18.861 > 11.345$ THERE IS SIGNIFICANT EVIDENCE OF ASSOCIATION (DEPENDENCE) BETWEEN THE LEVEL OF EDUCATION AND THE EXPECTED AVERAGE ANNUAL EARNINGS

THERE IS SUFFICIENT EVIDENCE TO REJECT H_0

Question 14 (***)

An investigation was carried out to determine the effectiveness of four different blood pressure lowering medications.

Each of the 100 patients who took part in the investigation was given one of the four available medications A, B, C or D.

- 10 of the 17 patients that were given medication A had a positive response.
- 16 of the 26 patients that were given medication B had a positive response.
- 15 of the 28 patients that were given medication C had a positive response.
- 11 of the 29 patients that were given medication D had a positive response.

The following claims are made.

a) Claim 1

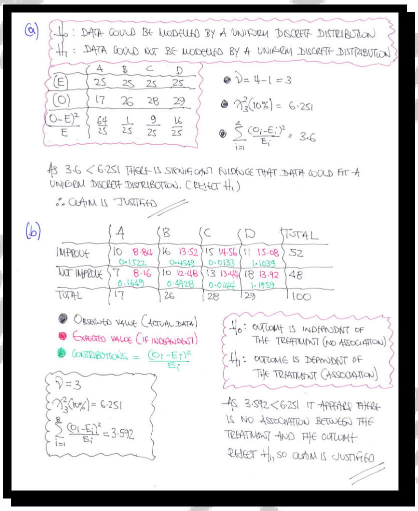
Each patient was randomly given one of the four medications.

b) Claim 2

The patient's response is independent of the medication that was given.

Test each of these claims at the 10% level of significance.

$\boxed{\text{claim 1 justified, } 3.6 < 6.251}$, $\boxed{\text{claim 2 justified, } 3.592 < 6.251}$



(a) H_0 : DATA COULD BE MODELLED BY A UNIFORM DISCRETE DISTRIBUTION

H_1 : DATA COULD NOT BE MODELLED BY A UNIFORM DISCRETE DISTRIBUTION

	A	B	C	D
(E)	25	25	25	25
(O)	17	26	28	29
$\frac{(O-E)^2}{E}$	$\frac{64}{25}$	$\frac{1}{25}$	$\frac{9}{25}$	$\frac{16}{25}$

- $\nu = 4-1 = 3$
- $\chi^2_3(10\%) = 6.251$
- $\sum_{i=1}^{4} \frac{(O_i-E_i)^2}{E_i} = 3.6$

AS $3.6 < 6.251$ THERE IS SIGNIFICANT EVIDENCE THAT DATA COULD FIT A UNIFORM DISCRETE DISTRIBUTION. (REJECT H_1)

$\therefore$ CLAIM IS JUSTIFIED

(b)

	A	B	C	D	TOTAL
IMPROVE	10 8.84 0.1522	16 13.52 0.4549	15 14.56 0.0133	11 15.08 1.1039	52
NOT IMPROVE	7 8.16 0.1649	10 12.48 0.4928	13 13.44 0.0144	18 13.92 1.1959	48
TOTAL	17	26	28	29	100

- OBSERVED VALUE (ACTUAL DATA)
- EXPECTED VALUE (IF INDEPENDENT)
- CONTRIBUTIONS $= \frac{(O_i-E_i)^2}{E_i}$

H_0 : OUTCOME IS INDEPENDENT OF THE TREATMENT (NO ASSOCIATION)

H_1 : OUTCOME IS DEPENDENT OF THE TREATMENT (ASSOCIATION)

$\nu = 3$

$\chi^2_3(10\%) = 6.251$

$\sum_{i=1}^{8} \frac{(O_i-E_i)^2}{E_i} = 3.592$

AS $3.592 < 6.251$ IT APPEARS THERE IS NO ASSOCIATION BETWEEN THE TREATMENT AND THE OUTCOME

REJECT H_1, SO CLAIM IS JUSTIFIED