UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH
FACULTY OF ARTS, HUMANITIES AND SOCIAL SCIENCES

END OF TERM ASSESSMENT PAPER

MODULE CODE: SO5041 **SEMESTER**: Autumn 2013

MODULE TITLE: Quantitative Research Methods I (MA Sociology) **EXAM DURATION**: Two hours

LECTURER: Dr. Brendan Halpin **% OF TOTAL MARKS**: 40%

EXTERNAL EXAMINER: Prof. Chris Whelan

INSTRUCTIONS TO CANDIDATES:

- Answer four questions: all questions carry ten points each
- Calculators allowed: Yes
- Dictionaries allowed: Yes

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1 Two types of t-test

(i) A group of students are given a short training course designed to teach memory skills. Their skills are tested before and after:

ID	Before	After
1.	85	83
2.	75	74
3.	58	69
4.	68	68
5.	66	71
6.	56	62
7.	87	89
8.	67	69
9.	57	68
10.	76	87

Test whether the course had an effect on their skills.

(ii) Table 1 shows Stata output for an independent-sample test on `rfimn`, monthly income, for respondents in work, aged 16-24, comparing male and female. Interpret the output and present the test of the hypothesis that income differs by gender.

Table 1: T-test on monthly income for respondents aged 16-24, in work, by sex (BHPS data, 2008)

```
Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
    male |     383    1279.526     33.6941    659.4065    1213.277    1345.776
  female |     467    1083.958    24.61009    531.8286    1035.597    1132.318
---------+--------------------------------------------------------------------
combined |     850    1172.079    20.59035    600.3066    1131.665    1212.493
---------+--------------------------------------------------------------------
    diff |            195.5687    40.85941                115.3712    275.7661
------------------------------------------------------------------------------
    diff = mean(male) - mean(female)                              t =   4.7864
Ho: diff = 0                                     degrees of freedom =      848

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

2 Table 2 is drawn from Irish data from successive European Social Surveys, and represents couples born in the 1940s and in the 1970s (percentage is row) classified according to their level of education.

(i) Describe the main features of the 1940s table
(ii) In what ways are the 1970s couples different?
(iii) What sorts of social processes are likely to be behind the general pattern in the tables?
(iv) Using the data provided with the 1940s table, carry out a statistical test for association between wife's and husband's educational level

Table 2: Qualifications of wife and husband, 1940s and 1970s cohorts, ESS Ireland

1940s Cohort

Wife's status	Husband's status: Low	Intermedi	Complete	Third lev	Total
Low	153	111	35	52	351
	43.59	31.62	9.97	14.81	100.00
Intermediate 2nd	92	80	38	73	283
	32.51	28.27	13.43	25.80	100.00
Complete 2nd	20	20	26	36	102
	19.61	19.61	25.49	35.29	100.00
Third level	34	34	29	173	270
	12.59	12.59	10.74	64.07	100.00
Total	299	245	128	334	1,006
	29.72	24.35	12.72	33.20	100.00

Pearson chi2(9) = 213.4555   Pr = 0.000

1970s Cohort

Wife's status	Husband's status: Low	Intermedi	Complete	Third lev	Total
Low	21	20	10	8	59
	35.59	33.90	16.95	13.56	100.00
Intermediate 2nd	37	120	34	52	243
	15.23	49.38	13.99	21.40	100.00
Complete 2nd	15	43	77	53	188
	7.98	22.87	40.96	28.19	100.00
Third level	12	85	63	354	514
	2.33	16.54	12.26	68.87	100.00
Total	85	268	184	467	1,004
	8.47	26.69	18.33	46.51	100.00

Pearson chi2(9) = 337.1388   Pr = 0.000

3 Write a short essay on the importance of generalisability in social research.

4 In a sample of 1000 potential voters, 447 support tax cuts. The mean age in the sample is 42.2 with a standard deviation of 10.5.

(i) Construct a 95% confidence interval around the sample estimate of mean age.

(ii) Construct a 99% confidence interval for the same measure, and identify how the result and meaning are different.

(iii) Construct a 95% confidence interval around the proportion that support tax cuts, and conduct a test of the hypothesis that less than 50% of the population support tax cuts.

(iv) When and why would one use the t from t-distribution in place of z from the standard normal distribution?

5 Write short notes on three of the following:

- The mean versus the median
- Questionnaire design
- Relative advantages of interviewer-delivered and self-completion questionnaires
- The Central Limit Theorem
- Probability versus non-probability sampling
- Reliability and validity in survey research

Table 3: Regression: QCA explained by CAO points

Source	SS	df	MS
Model	2827.48838	1	2827.48838
Residual	7874.14185	51671	.152389964
Total	10701.6302	51672	.207106948

Number of obs	= 51673
F(1, 51671)	=18554.30
Prob > F	= 0.0000
R-squared	= 0.2642
Adj R-squared	= 0.2642
Root MSE	= .39037

QCA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CAO	.0039285	.0000288	136.21	0.000	.003872	.003985
_cons	.9549992	.0131436	72.66	0.000	.9292376	.9807608

Table 4: CAO points and QCA, by gender

gender	mean(CAO)	mean(QCA)
Male	445.08	2.66
Female	457.62	2.79

6 Table 3 shows the results of a regression analysis where UL undergraduates' QCA (scale from 0 to 4) is predicted by their Leaving Certificate Examination points (range 260-600, variable `CAO`).

(i) Report the regression equation and explain it in words.
(ii) Predict the student's QCA for CAO points of 350, and of 550.
(iii) How much will the predicted QCA rise for a rise of 100 CAO points?
(iv) Report and interpret the R^2 figure.
(v) Test the hypothesis that CAO points have an effect on QCA.
(vi) Table 4 shows CAO points and QCA by gender. What does this show?
(vii) Table 5 reports the regression result also including gender as a dummy variable (indicating female). What extra insight do you get from this model, compared with the first?

Table 5: Regression results, also taking account of gender.

Source	SS	df	MS
Model	2895.6473	2	1447.82365
Residual	7805.98292	51670	.151073794
Total	10701.6302	51672	.207106948

Number of obs	= 51673
F(2, 51670)	= 9583.55
Prob > F	= 0.0000
R-squared	= 0.2706
Adj R-squared	= 0.2706
Root MSE	= .38868

QCA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CAO	.0038641	.0000289	133.82	0.000	.0038075	.0039207
female	.0732557	.0034489	21.24	0.000	.0664959	.0800154
_cons	.9446744	.0130958	72.14	0.000	.9190066	.9703423

Formulas and Tables

(a) Standard deviation:

$$\sigma = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}}$$

(b) z-score: If X is drawn from a normal distribution, with mean μ, and standard deviation σ, its corresponding z-score is:

$$z = \frac{X - \mu}{\sigma}$$

(c) Standard deviation for a proprortion, π:

$$\sigma_\pi = \sqrt{\pi(1-\pi)}$$

(d) Sample standard error, SE, depends on sample standard deviation, s, and sample size, n:

$$SE = \frac{s}{\sqrt{n}}$$

(e) Confidence interval around point estimate, ε, where z is the z-score for the required level of confidence, and SE the standard error (note: z-score may be derived from standard normal distribution or t-distribution, as appropriate):

$$\varepsilon \pm z \times SE$$

(f) Chi-squared statistic for a table,

$$X^2 = \sum \frac{(O-E)^2}{E}$$

where O is the observed value and E the expected value.

(g) Expected value under independence in a table:

$$E = \frac{rc}{T}$$

where r is the row total and c the column total for that cell, and T the grand total for the table.

(h) Predicted value from a bi-variate regression, where a is the constant and b the slope coefficient:

$$\hat{Y} = a + bx$$

(i) Standard error for comparing means of two sub-samples, whose variance may not be the same:

$$\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

where s_i is the standard deviation for group i, and n_i the number of cases in group i.

Table of the Standard Normal Distribution

Right tail (probability of $X > z$)

	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.00	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
.10	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
.20	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
.30	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
.40	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
.50	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
.60	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
.70	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
.80	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
.90	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.00	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.10	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.20	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.30	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.40	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.50	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.60	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.70	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.80	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.90	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.00	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
2.10	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
2.20	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
2.30	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
2.40	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
2.50	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
2.60	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
2.70	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
2.80	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
2.90	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
3.00	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
3.10	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
3.20	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
3.30	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
3.40	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
3.50	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002
3.60	.0002	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
3.70	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
3.80	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
3.90	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Table of Student's t Distribution

Two-tailed probability

Degrees of Freedom	Probability level (Area under both tails)				
	0.10	0.05	0.025	0.01	0.005
1	6.314	12.706	25.452	63.657	127.321
2	2.920	4.303	6.205	9.925	14.089
3	2.353	3.182	4.177	5.841	7.453
4	2.132	2.776	3.495	4.604	5.598
5	2.015	2.571	3.163	4.032	4.773
6	1.943	2.447	2.969	3.707	4.317
7	1.895	2.365	2.841	3.499	4.029
8	1.860	2.306	2.752	3.355	3.833
9	1.833	2.262	2.685	3.250	3.690
10	1.812	2.228	2.634	3.169	3.581
11	1.796	2.201	2.593	3.106	3.497
12	1.782	2.179	2.560	3.055	3.428
13	1.771	2.160	2.533	3.012	3.372
14	1.761	2.145	2.510	2.977	3.326
15	1.753	2.131	2.490	2.947	3.286
16	1.746	2.120	2.473	2.921	3.252
17	1.740	2.110	2.458	2.898	3.222
18	1.734	2.101	2.445	2.878	3.197
19	1.729	2.093	2.433	2.861	3.174
20	1.725	2.086	2.423	2.845	3.153
21	1.721	2.080	2.414	2.831	3.135
22	1.717	2.074	2.405	2.819	3.119
23	1.714	2.069	2.398	2.807	3.104
24	1.711	2.064	2.391	2.797	3.091
25	1.708	2.060	2.385	2.787	3.078
26	1.706	2.056	2.379	2.779	3.067
27	1.703	2.052	2.373	2.771	3.057
28	1.701	2.048	2.368	2.763	3.047
29	1.699	2.045	2.364	2.756	3.038
30	1.697	2.042	2.360	2.750	3.030
35	1.690	2.030	2.342	2.724	2.996
40	1.684	2.021	2.329	2.704	2.971
50	1.676	2.009	2.311	2.678	2.937
60	1.671	2.000	2.299	2.660	2.915
75	1.665	1.992	2.287	2.643	2.892
100	1.660	1.984	2.276	2.626	2.871
500	1.648	1.965	2.248	2.586	2.820
1000	1.646	1.962	2.245	2.581	2.813
100000	1.645	1.960	2.241	2.576	2.807

Table of the χ^2 distribution (chi-sq)

Values of the χ^2 statistic for various degrees of freedom and areas under the right tail

Degrees of	Area under right tail				
Freedom	0.100	0.050	0.025	0.010	0.005
1	2.706	3.841	5.024	6.635	7.879
2	4.605	5.991	7.378	9.210	10.597
3	6.251	7.815	9.348	11.345	12.838
4	7.779	9.488	11.143	13.277	14.860
5	9.236	11.070	12.833	15.086	16.750
6	10.645	12.592	14.449	16.812	18.548
7	12.017	14.067	16.013	18.475	20.278
8	13.362	15.507	17.535	20.090	21.955
9	14.684	16.919	19.023	21.666	23.589
10	15.987	18.307	20.483	23.209	25.188
11	17.275	19.675	21.920	24.725	26.757
12	18.549	21.026	23.337	26.217	28.300
13	19.812	22.362	24.736	27.688	29.819
14	21.064	23.685	26.119	29.141	31.319
15	22.307	24.996	27.488	30.578	32.801
16	23.542	26.296	28.845	32.000	34.267
17	24.769	27.587	30.191	33.409	35.718
18	25.989	28.869	31.526	34.805	37.156
19	27.204	30.144	32.852	36.191	38.582
20	28.412	31.410	34.170	37.566	39.997
21	29.615	32.671	35.479	38.932	41.401
22	30.813	33.924	36.781	40.289	42.796
23	32.007	35.172	38.076	41.638	44.181
24	33.196	36.415	39.364	42.980	45.559
25	34.382	37.652	40.646	44.314	46.928