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

END OF TERM ASSESSMENT PAPER

MODULE CODE: SO5041 **SEMESTER**: Autumn 2017

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

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

EXTERNAL EXAMINER: Prof. Emer Smyth

INSTRUCTIONS TO CANDIDATES:

- Answer question 1 (40%) and two others (30% each).
- Calculators allowed: Yes
- Dictionaries allowed: Yes

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1 **Data interpretation**: (Compulsory, 40%; answer this question and two others)
Stata output on the next page summarises evidence from the European Social Survey (ESS) on self-reported religiosity by age, gender, year and country. The ESS has been carried out every two years (from 2002 to 2016) in a large number of European countries. One of the questions it asks is "How religious are you?", with answers ranging from 0 ("Not at all religious") to 10 ("Very religious").
The tables on the next page report the average score for this variable, for selected countries (Germany, France, Great Britain, Ireland, Sweden), broken down by various categories:

(i) by country and gender
(ii) by country, gender and age group
(iii) by country, gender and year of survey
(iv) by country, gender and year of survey for those aged 15-40 only

Use these tables to write a short report on how religiosity differs by age, country and gender, and how it is changing over time.

Stata output: Self-reported religiosity from the European Social Survey

```
. table cntry gndr                    [aw=dw], c(mean rlgdgr) f(%5.2f) row col
```

Country	Gender Male	Female	Total
DE	4.24	5.01	4.62
FR	3.78	4.71	4.27
GB	3.93	4.76	4.38
IE	5.34	5.99	5.68
SE	3.38	4.27	3.83
Total	4.18	4.99	4.60

```
. table ageg gndr cntry               [aw=dw], c(mean rlgdgr) f(%5.2f) row col
```

	Country and Gender														
	DE			FR			GB			IE			SE		
Age group	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
<20	3.81	4.36	4.08	3.11	3.75	3.40	3.34	3.66	3.50	4.53	4.73	4.63	2.88	3.47	3.16
20	3.57	4.19	3.86	3.04	4.05	3.59	3.05	3.98	3.56	4.44	5.37	4.90	2.76	3.19	2.97
30	3.87	4.89	4.38	3.21	4.14	3.73	3.62	4.28	3.98	4.69	5.36	5.05	2.92	3.57	3.24
40	4.27	4.97	4.62	3.96	4.33	4.16	3.76	4.40	4.10	5.29	5.99	5.70	3.20	3.93	3.57
50	4.66	4.96	4.81	3.71	5.07	4.41	3.91	4.77	4.36	5.57	6.29	5.97	3.52	4.30	3.93
60	4.48	5.30	4.86	4.31	5.40	4.85	4.28	5.54	4.95	6.05	6.74	6.40	3.58	4.89	4.23
70	4.63	5.52	5.08	4.50	5.88	5.20	5.04	6.38	5.73	7.27	7.27	7.27	4.47	5.07	4.77
80+	4.91	6.84	6.13	5.50	6.14	5.86	5.86	6.12	6.01	6.87	8.19	7.57	5.00	7.51	6.37
Total	4.24	5.01	4.62	3.78	4.71	4.27	3.93	4.76	4.38	5.34	5.99	5.68	3.38	4.27	3.83

```
. table wave gndr cntry               [aw=dw], c(mean rlgdgr) f(%5.2f) row col
```

	Country and Gender														
	DE			FR			GB			IE			SE		
Survey Year	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2002	4.22	4.92	4.58	3.69	5.09	4.42	3.82	4.92	4.39	6.09	6.58	6.34	3.69	4.92	4.32
2004	4.29	5.45	4.90	3.50	4.69	4.12	4.42	5.06	4.75	6.30	6.96	6.68	3.60	4.66	4.12
2006	4.37	5.01	4.69	3.34	4.06	3.70	3.77	4.58	4.19	6.00	6.61	6.33	3.74	4.71	4.23
2008	4.28	5.25	4.73	3.60	4.23	3.94	3.95	4.39	4.18	5.54	5.85	5.70	3.32	4.01	3.66
2010	4.21	4.91	4.55	3.47	3.99	3.74	4.03	4.67	4.38	4.78	5.40	5.11	3.01	4.19	3.63
2012	4.40	5.09	4.74	4.11	4.98	4.58	4.64	5.56	5.16	4.96	5.71	5.35	3.04	3.69	3.36
2014	4.20	4.61	4.40	3.98	5.29	4.66	3.45	4.53	4.03	4.98	5.64	5.34	3.41	3.97	3.69
2016	4.00	4.86	4.41	4.46	5.37	4.93	3.41	4.36	3.93	4.68	5.50	5.11	3.09	3.73	3.41
Total	4.24	5.01	4.62	3.78	4.71	4.27	3.93	4.76	4.38	5.34	5.99	5.68	3.38	4.27	3.83

```
. table wave gndr cntry if inrange(agea,15,40) [aw=dw], c(mean rlgdgr) f(%5.2f) row col
```

	Country and Gender														
	DE			FR			GB			IE			SE		
Survey Year	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2002	3.92	4.27	4.09	2.80	4.09	3.45	3.27	4.20	3.74	5.08	5.96	5.52	3.46	4.38	3.91
2004	3.63	5.19	4.43	2.88	4.01	3.50	4.40	3.99	4.19	5.82	5.92	5.88	3.05	3.45	3.24
2006	3.31	4.81	4.05	2.78	3.39	3.09	3.18	3.75	3.48	5.14	6.76	6.03	2.83	3.43	3.11
2008	3.78	4.42	4.06	2.96	3.47	3.24	3.13	3.76	3.48	4.93	5.33	5.13	2.61	3.23	2.90
2010	3.64	4.42	4.03	2.95	3.54	3.27	3.69	4.27	4.01	4.03	4.83	4.43	2.44	3.32	2.90
2012	4.01	4.55	4.28	3.53	4.36	3.99	4.43	4.31	4.36	4.02	4.86	4.43	2.82	3.24	3.03
2014	4.14	4.25	4.20	3.36	4.96	4.25	3.07	4.20	3.68	4.43	4.94	4.70	2.79	3.27	3.02
2016	3.43	4.62	3.99	4.03	4.93	4.47	2.56	4.01	3.36	3.87	4.43	4.14	2.38	2.41	2.39
Total	3.73	4.57	4.14	3.16	4.08	3.65	3.46	4.06	3.78	4.58	5.33	4.97	2.86	3.42	3.13

2 **Use the normal and t-distributions, as appropriate, to answer the following questions:** (30%)

(i) Assume that it is known that average time spent travelling to and from work is normally distributed with a mean of 37 minutes per day, and a standard deviation of 11.0 minutes.

a. If we pick a person at random, what is the chance he/she spends more than an hour (60 minutes) travelling per day?

b. What proportion of the population spend more than 35 minutes per day?

c. What proportion spend between 30 and 50 minutes per day?

(ii) a. A sample of 16 people are asked to record how much time they spend on housework. The results are a mean time of 75 minutes per day, with a standard deviation of 12.5 minutes. Construct a 95% confidence interval around the mean and explain what it tells us about housework time in the reference population.

b. For the same sample, construct a 99% confidence interval; comment on the differences with respect to the 95% confidence interval

(iii) The following Stata output is based on the National Longitudinal Study of Women. It relates wage rate to whether the woman has a college degree.

```
. ttest wage, by(collgrad)
Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
not coll	1,714	6.910561	.1276104	5.283132	6.660273	7.16085
college	532	10.52606	.2742596	6.325833	9.987296	11.06483
combined	2,246	7.766949	.1214451	5.755523	7.528793	8.005105
diff		-3.615502	.2753268		-4.155424	-3.07558

```
    diff = mean(not coll) - mean(college)                     t = -13.1317
Ho: diff = 0                                     degrees of freedom =     2244

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

a. Report the key descriptive information that the output presents

b. Report the results of a statistical test for association between college graduate status and wage

3 **Essay question**: (30%)

Write a short essay on the strengths and weaknesses of quantitative methods in social research.

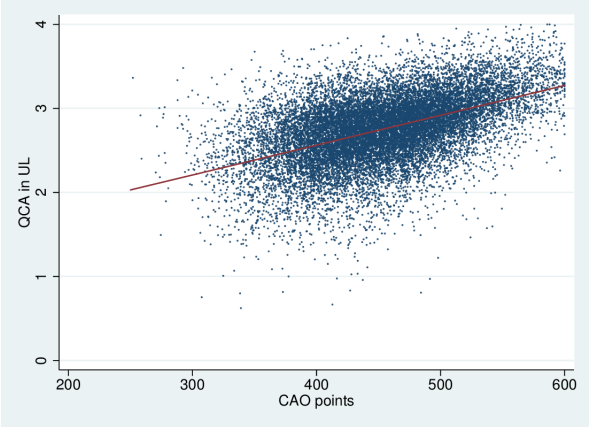
In your answer discuss whether the ESS data described in question 1 is or is not a valuable resource to address research questions about complex topics such as religiosity.

4 **Predicting performance in college**: (30%)
In UL, students' performance in modules is averaged into a QCA score, which varies between 0 and 4. We use the students' performance on the Leaving Certificate exam prior to entering college (summarised as CAO points, with a maximum of 600) to predict their performance in college, using a regression analysis (see below, note also the scatterplot relating the variables).

```
. reg qca cao
```

Source	SS	df	MS	Number of obs	=	18,139
				F(1, 18137)	=	6080.77
Model	717.311097	1	717.311097	Prob > F	=	0.0000
Residual	2139.51132	18,137	.117963904	R-squared	=	0.2511
				Adj R-squared	=	0.2510
Total	2856.82242	18,138	.15750482	Root MSE	=	.34346

qcaval	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cao	.0035523	.0000456	77.98	0.000	.003463	.0036416
_cons	1.142041	.0207992	54.91	0.000	1.101273	1.18281



- Report the regression equation in the form $Y = a + b \times X$
- Use the regression equation to predict the QCA for a student with CAO points of:
  - 300
  - 500
- Sketch the regression line on a graph, showing your calculations
- Carry out and report a statistical test on whether CAO points have an effect on QCA
- Report and interpret the R^2 value.
- Do CAO points predict QCA performance well (have reference to the scatter plot and R^2)?

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 Freedom	Area under right tail				
	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