

Voter turnout in industrial democracies

A study of demographic, economic and geographical explanatory factors

Hugo Chesshire

The issue of voter turnout has become problematic for many liberal democracies. It is of particular urgency in Canada, where turnout has dropped to unprecedented lows, reaching 58.8% in the 2008 election. This raises questions about the legitimacy of the regime, for even a “majority” government with this sort of turnout will not have the votes of a majority of the electorate. This is even more acute in some of the countries studied where turnout in the most recent election dropped below 50%, where no party could truly say it had a majority mandate. In this study, I have examined fifteen liberal democracies from the 30 monitored by the Organization for Economic Co-operation and Development (OECD) and searched for correlations between voter turnout and a variety of demographic, economic and geographical variables. This study should be viewed as preliminary, for if one or more of these factors correlates to voter turnout, it would not necessarily mean that it had caused a difference in turnout, or vice versa; it could also be that both are the results of a third and uninvestigated cause.

The ten selected countries are all industrialized and stable democracies with market economies, generally understood to be in the 'developed world', which is important simply for the purposes of comparing like with like. They were randomly selected from the 30 market-economy democracies that the OECD tracks, but only after eliminating countries with mandatory voting laws. Whether actively enforced, as in Australia, or legislated but effectively ignored, as in Belgium, the presence of such legislation introduces another variable whose influence would very probably be strong enough to mask that of any other factor. When considering factors affecting voter turnout, it is important that the voters be free not to turn out.

The voter turnouts were drawn from national elections between 2004 and 2007, due to the

ready availability of data gathered with a consistent methodology in those years. The election could be either parliamentary or presidential. The statistical data for the other variables in each country was drawn from the same year that the election took place, to eliminate possible changes before or since that might invalidate the results. Full data is found in Appendix 1.

We should be able to make some prediction of the average voter turnout for OECD countries from our data. The samples have a wide range, from Spain at 42.32%, to the USA at 88.5%. The average OECD turnout should be between 62% and 77%¹. The standard deviation of this sample is 13%, and the mean of the sample 69.43%. From this, we can quickly see the outliers: Poland, the Slovak Republic and Spain are notable for being over 1 standard deviation below from the mean, and Italy and the United States are both over 1 standard deviation above. When analyzing the data, particular attention might be paid to these countries to find out why their turnouts might be much higher or lower than average.

The first independent variable studied was education. This was measured as the number of university graduates, as a portion of the overall population. Since all the countries have relatively similar standards for university graduation (duration of undergraduate courses, university accreditation and so forth), and similar literacy rates and incidence of primary and secondary education, this should be a good general indicator of differences in the higher education of the population. Because almost no students would have the opportunity to graduate before the age of 21, the number of graduates was only considered as a portion of the population over 20; this prevents errors such as mistaking a relatively youthful population as relatively uneducated. The data is quite consistent, and a mean of 1.54% of those over 20 will have a graduate degree, with a standard deviation of 0.39%. However, the evidence does not suggest

¹ See Appendix 2, calculation 1.

any correlation between an above- or below-average percentage of graduates and voter turnout.²

It is often believed that older people vote more than the young, who are perhaps more likely to be disenchanted with politics. However, as the populations of the established market democracies grow predominantly older, the predominant concern seems to be that voter turnout is decreasing, not increasing. To analyze this, I examined the proportion of the population in each country that was aged 20-29, and the proportion that was over 40. Comparing these to the voter turnouts, the evidence suggests that the relative age or youth of a country's population is definitely correlated with voter turnout.³ Further analysis shows strong a correlation between an above-average number of voters aged 20-29 and a below-average voter turnout, but the proportion of the population aged 40 or above is not significantly related to voter turnout.⁴ It may not be true that the over-40s vote more, but there seems to be something to the notion that the young vote less.

There are also a number of economic factors that may be related to voter turnout. Since the mid-1970s, the prevalence of part-time jobs has grown since the 1950s and 1960s, which may be a factor in the decreased voter turnout in the same period. A population which is suffering from a move from secure, full-time employment to insecure, part-time work may be disenchanted with the political system that has allowed it to happen after the 'golden age' of the post-war Keynesian compromise. To examine this, I looked at the ratio of full-time to part-time jobs in each country, i.e. the number of full-time jobs that existed for each part-time job, based on a common definition from OECD. The results were far-ranging, with a mean ratio of 9.26 and a very large standard deviation of 10.4. The reason for this is two extreme outliers in the

2 See Appendix 2, calculation 2.

3 See Appendix 2, calculation 3.

4 See Appendix 2, calculations 4 & 5.

former Czechoslovakia, and if they were removed from the calculation, the mean became 5.47, and the standard deviation only 2.35. This discrepancy was interesting, but upon further investigation it did not appear that voter turnout in Czechoslovak countries was significantly different to that in others.⁵ However, the ratio of full-time to part-time employment may well be related to voter turnout, although not nearly as strongly as the relative youth of the population.⁶

If this correlation was in some way due to a growing conviction amongst the workforce about a lack of political efficacy, then a comparison of discouraged workers to voter turnout should be revealing. The discouraged workforce is measured as the number of unemployed workers who believe that there is simply no work available for them. In countries with a higher-than-average number of discouraged workers, one might expect to find a depressed voter turnout as people reject a system that seems to be failing them; but conversely, it also would not be outlandish to also expect an increased voter turnout as discouraged workers might choose to support a party of change. Data was not available for all countries in the study, but for those that were, the evidence suggests that there is a correlation between voter turnout and the relative numbers of discouraged workers.⁷ These employment statistics show that there may be some truth to the notion that globalization, the shift to more insecure work and general disenchantment may be related to declining voter turnouts.

On the subject of disenchantment with the economic system, there is also the question of the distribution of wealth. I have studied the Gini inequality coefficient, measured after adjustment for taxes and transfers, which rates the equality of the distribution of wealth in each country on a scale of 0-1, where 0 represents a perfectly equal distribution, and 1, a perfectly

5 See Appendix 2, calculation 6.

6 See Appendix 2, calculation 7.

7 See Appendix 2, calculation 8.

unequal distribution. There is a relation between the distribution of wealth and voter turnout, which might be explained by a lack of political efficacy felt, especially if voters come to believe that big business and the wealthy are increasingly in control of ostensibly democratic countries.⁸ The USA is a notable exception, with a very high voter turnout and a very high inequality of distribution of wealth, which may well be related to the American culture of self-improvement and the belief that a person has the power to make himself wealthy no matter what his circumstances, which is decidedly less prevalent in Europe.

A final economic factor I wish to examine is per-capita GDP. Economic prosperity lends credibility to any regime, and economic failure can quickly sap it. A perfect example can be seen in pre- and post-war Germany, where the Great Depression destroyed pre-war German democracy and a post-war boom legitimized the post-war regime. Per-capita GDP has been adjusted for purchasing power parity and expressed relative to US dollars at their value in the year 2000, to eliminate discrepancies with spending power in different economies. The data does seem to support the idea that wealth legitimizes democracy, there is a strong correlation between per-capita GDP and voter turnout.⁹

Finally, the OECD countries are a mix of older, established democracies such as Britain, France or the USA, and newly-minted former Eastern Bloc countries such as Poland or the Czech Republic, which have only become market democracies since 1989. I wanted to see if there was a significant difference in voter turnout between the two, and the data suggests there is.¹⁰ In the same spirit, I also checked for differences between the North American democracies and the Europeans, and between the Scandinavian and the European, as the Scandinavian and

8 See Appendix 2, calculation 9.

9 See Appendix 2, Calculation 10.

10 See Appendix 2, Calculation 11.

North American countries are notable for significant social and political differences from the rest of Europe, with Scandinavia tending towards greater social democracy and North America towards more classical liberalism than the European 'norm'. In all cases, there were differences, although the Scandinavian countries are much more strongly differentiated to a general European norm than the North American countries.¹¹

In this study, it was the economic differences that correlated most strongly with voter turnout. The only significant demographic correlation seemed to show that an above-average proportion of 20-29-year-olds does produce a below-average voter turnout. The ratio of full-time to part-time employees had a fair significance, but much greater were the correlations between the ratio of discouraged workers and the inequality of wealth, and greatest of all was the correlation between per-capita GDP and voter turnout. There may be a significant connection between the end of the post-war compromise and the increasing prevalence of globalization and neoliberalism and decreasing voter turnouts, which would justify further investigation.

¹¹ See Appendix 2, Calculations 12 & 13.

Citations

Organization for Economic Co-operation and Development statistics portal,
http://www.oecd.org/statsportal/0,3352,en_2825_293564_1_1_1_1_1,00.html (accessed November 19th, 2009).

International Foundation for Electoral Systems, Election Guide,
<http://www.electionguide.org/index.php> (accessed November 19th, 2009).

Appendix 1: Data

	Austria	Canada	Czech Repub.	Ireland	Italy	Netherlands	New Zealand
Last election	2006	2006	2006	2007	2006	2006	2005
Turnout	78.49%	64.94%	64.42%	67.03%	83.50%	80.35%	81.01%
Population	8,267,900	32,576,000	10,267,000	4,239,848	58,435,000	16,357,992	4,185,000
Population over 20	6,461,462	24,457,279	8,112,150	3,085,142	47,241,805	12,471,593	2,997,680
Graduates	92,451	358,512	118,152	71,984	578,294	197,201	61,026
Graduates as percentage of population over 20	1.43%	1.47%	1.46%	2.33%	1.22%	1.58%	2.04%
Population over 40	4,147,034	15,418,859	4,978,072	1,698,123	31,183,247	8,081,753	1,815,010
Population over 40 as percentage of population	50.16%	47.33%	48.49%	40.05%	53.36%	49.41%	43.37%
Population aged 20-29	1,046,720	4,482,015	1,561,853	717,070	6,961,114	1,954,221	551,710
Population aged 20-29 as percentage of population	12.66%	13.76%	15.21%	16.91%	11.91%	11.95%	13.18%
Full-time employed	3,109,000	13,513,000	4,668,000	1,495,000	19,014,000	5,316,000	1,642,000
Part-time employed	650,000	2,979,000	160,000	380,000	3,332,000	2,925,000	445,000
Ratio of full-time to part-time employees	4.78	4.54	29.18	3.93	5.71	1.82	3.69
Part-time employees relative to population aged 20-29	0.62	0.66	0.1	0.53	0.48	1.5	0.81
Workforce	5,585,900	22,599,000	7,307,000	2,984,600	38,726,000	11,025,100	2,747,000
Discouraged workers	7,000	24,000	NA	NA	814,000	116,000	3,000
Discouraged workers as percentage of workforce	0.13%	0.11%	NA	NA	2.10%	1.05%	0.11%
Gini inequality coefficient after taxes and transfers	0.27	0.32	0.27	0.33	0.35	0.27	0.34
Per-capita GDP	\$31,174.60	\$31,182.80	\$19,228.20	\$35,189.10	\$26,337.00	\$31,594.80	\$23,420.90

	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	United Kingdom	United States	Mean	Standard Deviation
Last election	2005	2007	2006	2006	2005	2006	2005	2004	2005.73	0.8
Turnout	77.44%	53.81%	61.53%	54.67%	42.32%	81.99%	61.40%	88.50%	69.43%	13.35%
Population	4,709,153	38,125,479	10,585,900	5,391,200	43,038,035	9,148,092	60,059,858	293,683,158	39,937,974.33	72,917,203.76
Population over 20	3,473,469	29,314,999	8,351,464	4,088,786	35,475,676	6,940,765	45,986,204	217,181,738	30,376,014.13	53,996,197.46
Graduates	58,886	532,724	66,317	80,210	371,899	89,153	679,959	3,089,000	429,717.87	765,880.01
Graduates as percentage of population over 20	1.70%	1.82%	0.79%	1.96%	1.05%	1.28%	1.48%	1.42%	1.54%	0.39%
Population over 40	2,212,786	17,645,865	5,204,251	2,376,523	21,567,142	4,621,145	29,519,642	135,173,448	19,042,860.00	33,661,043.64
Population over 40 as percentage of population	46.99%	46.28%	49.16%	44.08%	50.11%	50.51%	49.15%	46.03%	47.63%	3.33%
Population aged 20-29	562,744	6,404,395	1,513,702	919,169	6,505,094	1,089,311	7,993,403	41,969,584	5,615,473.67	10,409,567.72
Population aged 20-29 as percentage of population	11.95%	16.80%	14.30%	17.05%	15.11%	11.91%	13.31%	14.29%	14.02%	1.86%
Full-time employed	1,806,000	13,705,000	4,648,000	2,088,000	16,014,000	3,751,000	21,278,000	107,141,000	14,612,533.33	26,491,786.10
Part-time employed	473,000	1,534,000	476,000	54,000	2,040,000	582,000	6,496,000	16,351,000	2,591,800.00	4,186,895.58
Ratio of full-time to part-time employees	3.82	8.93	9.76	38.67	7.85	6.45	3.28	6.55	9.26	10.4
Part-time employees relative to population aged 20-29	0.84	0.24	0.31	0.06	0.31	0.53	0.81	0.39	0.55	0.36
Workforce	3,035,100	27,035,000	7,115,800	3,871,000	29,839,000	5,952,000	39,795,700	195,853,700	26,898,126.67	48,590,317.14
Discouraged workers	9,000	NA	21,000	NA	302,000	94,000	36,000	465,000	171,909.09	258,783.48
Discouraged workers as percentage of workforce	0.30%	NA	0.30%	NA	1.01%	1.58%	0.09%	0.24%	0.64%	0.70%
Gini inequality coefficient after taxes and transfers	0.28	0.37	0.38	0.27	0.32	0.23	0.34	0.38	0.31	0.05
Per-capita GDP	\$39,681.20	\$13,093.20	\$17,458.10	\$15,143.60	\$23,766.40	\$32,035.50	\$29,359.40	\$38,312.50	\$27,131.82	\$8,244.79

Appendix 2: Calculations

1: 95% confidence interval for mean electoral turnout

$$95 \text{ CI} = (\bar{X} \mp t_c * se) = .6943 \mp (2.145 * 0.0336) = 0.62 \Leftrightarrow .77$$

$$\bar{X} = 0.6943 \quad t_c = 2.145 \quad se = sd / \sqrt{n} = 0.13 / 3.87 = 0.0336$$

14 degrees of freedom, 2-tailed test at $\alpha = 0.05$.

2: Cross tabulation and analysis of voter turnout versus graduate education

		Below average proportion of graduates	Above average proportion of graduates	Total
Below average voter turnout	Observed	5	2	7
	Percentage	50%	40%	
	Expected	4.67	2.33	
Above average voter turnout	Observed	5	3	8
	Percentage	50%	60%	
	Expected	5.33	2.67	
	Total	10	5	15

Observed	Expected	o-e	(o-e) ²	((o-e) ² / e)
5	4.67	0.33	0.11	0.51
2	2.33	-0.33	0.11	0.25
5	5.33	-0.33	0.11	0.58
3	2.67	0.33	0.11	0.29

1.63

H₀: There is no relation between voter turnout and graduate education.

H₁: There is a relation between voter turnout and graduate education.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs < χ^2 critical, therefore, do not reject null hypothesis: no evidence at 0.05 level of significance to suggest that education level and voter turnout are related.

3: Cross tabulation and analysis of voter turnout versus age

		Above average young	Above average old	Neither	Both
Below average voter turnout	Observed	4	1	1	2
	Percentage	80%	20%	33%	100%
	Expected	2.67	2.67	1.6	1.07
Above average voter turnout	Observed	1	4	2	0
	Percentage	20%	80%	67%	0%
	Expected	2.33	2.33	1.4	0.93
<i>Total</i>		5	5	3	2

Observed	Expected	o-e	(o-e) ²	((o-e) ²)/e
4	2.67	1.33	1.77	4.72
1	2.67	-1.67	2.79	7.45
1	1.6	-0.6	0.36	0.58
2	1.07	0.93	0.86	0.93
1	2.33	-1.33	1.77	4.12
4	2.33	1.67	2.79	6.5
2	1.4	0.6	0.36	0.5
0	0.93	-0.93	0.86	0.8

25.6

H₀: There is no relation between voter turnout and age.

H₁: There is a relation between voter turnout and age.

3 degrees of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 7.81. χ^2 obs > χ^2 critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that age is correlated to voter turnout.

4: Cross tabulation and analysis of voter turnout versus population youth

		Below average youth	Above average youth	Total
Below average voter turnout	Observed	2	6	8
	Percentage	25%	86%	
	Expected	4.27	3.73	
Above average voter turnout	Observed	6	1	7
	Percentage	75%	14%	
	Expected	3.73	3.27	
	Total	8	7	15

Observed	Expected	o-e	(o-e) ²	((o-e) ²) e
2	4.27	-2.27	5.15	22
6	3.73	2.27	5.15	19.22
6	3.73	2.27	5.15	19.22
1	3.27	-2.27	5.15	16.85
				<u>77.29</u>

H₀: There is no relation between voter turnout and population youth.

H₁: There is a relation between voter turnout and population youth.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs > χ^2 critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that population youth is correlated to voter turnout.

5: Cross tabulation and analysis of voter turnout versus prevalence of over-40 population

		Below average over 40	Above average over 40	Total
Below average voter turnout	Observed	4	4	8
	Percentage	57%	50%	
	Expected	3.73	4.27	
Above average voter turnout	Observed	3	4	7
	Percentage	43%	50%	
	Expected	3.27	3.73	
Total		7	8	15

Observed	Expected	o-e	(o-e) ²	((o-e) ² e
4	3.73	0.27	0.07	0.27
4	4.27	-0.27	0.07	0.3
3	3.27	-0.27	0.07	0.23
4	3.73	0.27	0.07	0.27

1.07

H₀: There is no relation between voter turnout and prevalence of over-40 population .

H₁: There is a relation between voter turnout and prevalence of over-40 population.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs < χ^2 critical, therefore, do not reject null hypothesis: evidence at 0.05 level of significance suggests that prevalence of over-40 population is not related to voter turnout.

6: Testing means of Czechoslovak versus non-Czechoslovak turnouts

H₀: The average turnout in the Czechoslovak countries is no different than in non-Czechoslovak countries.

H₁: The average turnout in the Czechoslovak countries is different to that in non-Czechoslovak countries.

	Mean	sd	n
Non-Czechoslovak	.7095	0.14	13
Czechoslovak	.5955	0.07	2

$$H_0: \bar{X}_1 = \bar{X}_2 \quad H_1: \bar{X}_1 \neq \bar{X}_2$$

Degrees of freedom = $n_1 + n_2 - 2 = 13$. T-critical for two-tailed test at $\alpha = 0.05$ is 2.16.

$$se = \sqrt{\frac{sd_1^2}{n_1} + \frac{sd_2^2}{n_2}} = \sqrt{\frac{0.14^2}{13} + \frac{0.07^2}{2}} = \sqrt{\frac{0.0196}{13} + \frac{0.0049}{2}} = .0629$$

$$t-obs = \frac{\bar{X}_1 - \bar{X}_2}{se} = \frac{.7095 - .5955}{.0629} = 1.812$$

T-obs < t-critical, therefore, do not reject null hypothesis: evidence at 0.05 level of significance suggests that the average voter turnout in Czechoslovak countries is no different to that in non-Czechoslovak countries.

7: Cross tabulation and analysis of voter turnout versus full-time: part-time employment ratio

		Below average ratio	Above average ratio	Total
Below average voter turnout	Observed	8	2	10
	Percentage	62%	100%	
	Expected	8.67	1.33	
Above average voter turnout	Observed	5	0	5
	Percentage	38%	0%	
	Expected	4.33	0.67	
Total		13	2	15

Observed	Expected	o-e	(o-e) ²	((o-e) ² / e)
8	8.67	-0.67	0.44	3.85
2	1.33	0.67	0.44	0.59
5	4.33	0.67	0.44	1.93
0	0.67	-0.67	0.44	0.3

6.67

H_0 : There is no relation between voter turnout and full-time: part-time employment ratio.

H_1 : There is a relation between voter turnout and full-time: part-time employment ratio.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs $>$ χ^2 critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that full-time: part-time employment ratio is correlated to voter turnout.

8: Cross tabulation and analysis of voter turnout versus ratio of discouraged workers

		Below average discouraged	Above average discouraged	Total
Below average voter turnout	Observed	5	1	6
	Percentage	71%	25%	
	Expected	3.82	2.18	
Above average voter turnout	Observed	2	3	5
	Percentage	29%	75%	
	Expected	3.18	1.82	
Total		7	4	11

Observed	Expected	o-e	(o-e) ²	((o-e) ² / e)
5	3.82	1.18	1.4	5.33
1	2.18	-1.18	1.4	3.05
2	3.18	-1.18	1.4	4.44
3	1.82	1.18	1.4	2.54

15.36

H₀: There is no relation between voter turnout and proportion of discouraged workers.

H₁: There is a relation between voter turnout and proportion of discouraged workers.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs > χ^2 critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that there is a correlation between voter turnout and proportion of discouraged workers.

9: Cross tabulation and analysis of voter turnout versus Gini coefficient of wealth inequality

		Below average Gini coefficient	Above average Gini coefficient	Total
Below average voter turnout	Observed	2	6	8
	Percentage	33%	67%	
	Expected	3.2	4.8	
Above average voter turnout	Observed	4	3	7
	Percentage	67%	33%	
	Expected	2.80	4.20	
Total		6	9	15

Observed	Expected	o-e	(o-e) ²	((o-e) ² / e)
2	3.2	-1.2	1.44	4.61
6	4.8	1.2	1.44	6.91
4	2.8	1.2	1.44	4.03
3	4.2	-1.2	1.44	6.05

21.6

H₀: There is no relation between voter turnout and distribution of wealth.

H₁: There is a relation between voter turnout and distribution of wealth.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs > χ^2 critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that there is a correlation between voter turnout and the equality of the distribution of wealth.

10: Cross tabulation and analysis of voter turnout versus per-capita GDP

		Below average per-capita GDP	Above average per-capita GDP	Total
Below average voter turnout	Observed	5	3	8
	Percentage	71%	38%	
	Expected	3.73	4.27	
Above average voter turnout	Observed	2	5	7
	Percentage	29%	63%	
	Expected	3.27	3.73	
Total		7	8	15

Observed	Expected	o-e	(o-e) ²	((o-e) ² / e)
5	3.73	1.27	1.6	5.99
3	4.27	-1.27	1.6	6.85
2	3.27	-1.27	1.6	5.24
5	3.73	1.27	1.6	5.99
24.07				

H₀: There is no relation between voter turnout and per-capita GDP.

H₁: There is a relation between voter turnout and per-capita GDP.

1 degree of freedom, 1-tailed χ^2 test at $\alpha = 0.05$. χ^2 critical is 3.84. χ^2 obs > χ^2 critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that there is a correlation between voter turnout and per-capita GDP.

11: Testing means of former Eastern Bloc versus non-Eastern Bloc turnouts

H₀: The average turnout in the former Communist countries is no different than in non-Communist countries.

H₁: The average turnout in the Communist countries is different to that in non-Communist countries.

	Mean	sd	n
Non-Communist	.7238	0.13	12
Former Communist	.5763	0.05	3

$$H_0: \bar{X}_1 = \bar{X}_2 \quad H_1: \bar{X}_1 \neq \bar{X}_2$$

Degrees of freedom = $n_1 + n_2 - 2 = 13$. T-critical for two-tailed test at $\alpha = 0.05$ is 2.16.

$$se = \sqrt{\frac{sd_1^2}{n_1} + \frac{sd_2^2}{n_2}} = \sqrt{\frac{0.13^2}{12} + \frac{0.05^2}{3}} = \sqrt{\frac{.0169}{12} + \frac{.0025}{3}} = .00224$$

$$t-obs = \frac{\bar{X}_1 - \bar{X}_2}{se} = \frac{.7238 - .5763}{.00224} = 61.458$$

T-obs > t-critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that the average voter turnout in former Communist countries is different to that in countries that had never been Communist.

12: Testing means of North American versus European turnouts

H₀: The average turnout in North American countries is no different than in European countries.

H₁: The average turnout in North American countries is different to that in European countries.

$$H_0: \bar{X}_1 = \bar{X}_2 \quad H_1: \bar{X}_1 \neq \bar{X}_2$$

Degrees of freedom = n₁ + n₂ - 2 = 12. T-critical for two-tailed test at α = 0.05 is 2.179.

	Mean	sd	n
North American	.7672	0.17	2
European	.6725	0.13	12

$$se = \sqrt{\frac{sd_1^2}{n_1} + \frac{sd_2^2}{n_2}} = \sqrt{\frac{0.17^2}{2} + \frac{0.13^2}{13}} = \sqrt{\frac{.0289}{2} + \frac{.0169}{12}} = .01586$$

$$t-obs = \frac{\bar{X}_1 - \bar{X}_2}{se} = \frac{.7672 - .6725}{.01586} = 5.971$$

T-obs > t-critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that the average voter turnout in North American countries is different to that in Europe.

13: Testing means of Scandinavian versus non-Scandinavian European turnouts

H₀: The average turnout in Scandinavian countries is no different than in other European countries.

H₁: The average turnout in Scandinavian countries is different to that in other European countries.

	Mean	sd	n
Scandiavian	.7972	0.03	2
European	.6475	0.13	10

$$H_0: \bar{X}_1 = \bar{X}_2 \quad H_1: \bar{X}_1 \neq \bar{X}_2$$

Degrees of freedom = n₁ + n₂ - 2 = 10. T-critical for two-tailed test at α = 0.05 is 2.228.

$$se = \sqrt{\frac{sd_1^2}{n_1} + \frac{sd_2^2}{n_2}} = \sqrt{\frac{0.03^2}{2} + \frac{0.13^2}{10}} = \sqrt{\frac{.0009}{2} + \frac{.0169}{10}} = .00214$$
$$t-obs = \frac{\bar{X}_1 - \bar{X}_2}{se} = \frac{.7972 - .6475}{.00214} = 69.95$$

T-obs > t-critical, therefore, reject null hypothesis: evidence at 0.05 level of significance suggests that the average voter turnout in Scandinavian countries is different to that in other European countries.