1. [9 marks]

The Green Party won 4.5% of the popular vote in the 2006 general election. A recent poll taken on October 12, 2008 by Harris-Decima reported that 9% of a sample of 1000 respondents support the Green Party.

(a) Test at the .05 level of significance whether the Harris-Decima results support the contention that the Green Party has garnered more popular support since the last election.

[4]

(b) What is the probability-value (p-value) of the sample result?

[1]

(c) Calculate a 95% 1-sided confidence interval for the current level of support for the Green Party.

[2]

(d) Suppose you want to estimate the currrent level of support using a 95% 2-sided confidence interval What sample size would be required to obtain a margin of error of plus or minus 1%?

[2]

2. [11 marks]

A random sample of 60 families in Ottawa-Vanier has an average income of $92,000 and a standard deviation of $31,000, while a random sample of 40 families in Ottawa-Orleans has an average income of $108,000 and a standard deviation of $23,000.

(a) Test at the .01 level of significance whether these data constitute sufficient evidence to show a difference in average income in the respective populations of Ottawa-Vanier and Ottawa-Orleans.

[4]

(b) What is the p-value for the result in (a)?

[2]

(c) Calculate a 95% confidence interval for the difference in the average incomes between the two populations.

[3]

(d) What key assumptions must be satisfied to justify the calculations above? Do you think these are warranted? Explain briefly.

[2]

3. [10 marks]

The Canada Revenue Agency (CRA) implemented a paperwork simplification program (PSP) which it hopes will decrease the number of inquiries from taxpayers to its telephone response system. A random sample of fourteen offices were asked to collect data on number of inquiries the year before the PSP was implemented, and then to repeat the process the year after the PSP was implemented.

The program evaluation officer would like to show that PSP has cut down on the average number of calls. The MINITAB output can be found in Appendix A.

(a) Does the experimental design call for an independent samples test or a paired sample test. Explain briefly.

[1]

(b) Now look at the graphs. Explain whether a parametric t-test or a non-parametric test is more appropriate, with reference to specific graphs. Identify the most appropriate test.

[2]

(c) Using the test identified above, determine at the .05 level of significance whether the PSP has been effective at reducing the average (mean or median) number of calls.

[4]

(d) If you completed a parametric test above, now perform a non-parametric test. If you completed a non-parametric test above, now perform a parametric test.

[3]

4. [5 marks]

The following problem is from Siegel, **Practical Business Statistics, 2nd Ed.**

In the period following the crash of October 19, 1987, the market was generally believed to be in a volatile state. You can measure the extent of this volatibility by using the standard deviation of the daily changes in the Dow Jones Index:

Standard Deviation	Time Period
.0117	August 1 to October 9 (10 weeks)
.0836	October 12 (1 week before) to October 26 (1 week after)
.0209	October 27 to December 31, 1987 (9 weeks)

(a) Test to see if there is a difference in the underlying volatility of the market between the first and third periods above (excluding the two weeks around the crash itself). Clearly state the level of significance you are permitted to use given the statistical tables and **assume that there were 5 observations for each week**.

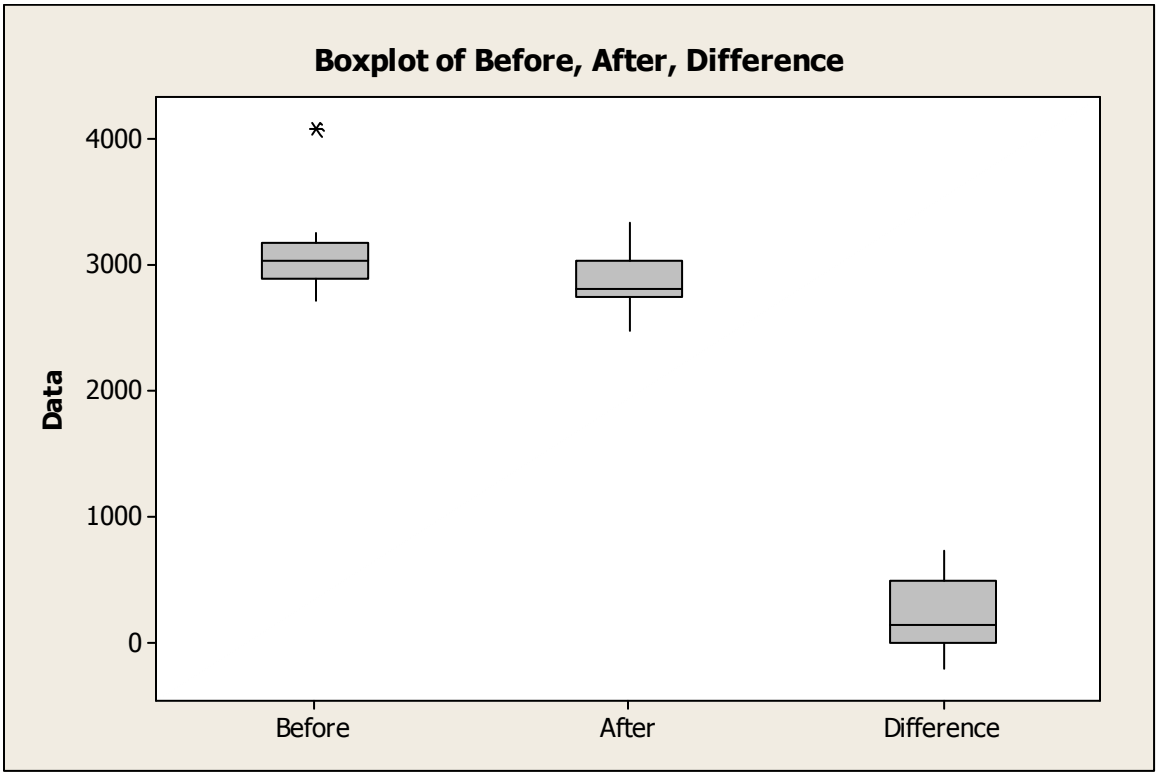
[4]

(b) What key assumptions are required to justify the test performed? Be brief but precise.

[1]

Appendix A.

Before	After	Difference
3253	2770	483
3069	3037	32
2708	2907	-199
2826	2785	41
3208	2598	610
2899	3029	-130
4072	3338	734
2964	2788	176
2987	2821	166
2983	2468	515
2828	2692	136
3090	2762	328
3101	2968	133
3154	3216	-62



Two-Sample T-Test and CI: Before, After

```
Two-sample T for Before vs After

                          SE
         N  Mean  StDev  Mean
Before  14  3082    324    87
After   14  2870    233    62


Difference = mu (Before) - mu (After)
Estimate for difference:  211.643
95% lower bound for difference:  28.628
T-Test of difference = 0 (vs >): T-Value = 1.98  P-Value = 0.030  DF = 23
```

Paired T-Test and CI: Before, After

```
Paired T for Before - After

             N     Mean    StDev  SE Mean
Before      14  3081.57   324.29    86.67
After       14  2869.93   233.40    62.38
Difference  14  211.643  283.877   75.869


95% lower bound for mean difference: 77.283
T-Test of mean difference = 0 (vs > 0): T-Value = 2.79  P-Value = 0.008
```

Wilcoxon Signed Rank Test: Difference

```
Test of median = 0.000000 versus median > 0.000000

                 N
                for   Wilcoxon         Estimated
             N  Test  Statistic      P     Median
Difference  14    14       89.0  0.012      184.5
```

Mann-Whitney Test and CI: Before, After

```
         N  Median
Before  14  3028.0
After   14  2804.5


Point estimate for ETA1-ETA2 is 184.5
95.4 Percent CI for ETA1-ETA2 is (6.9,358.1)
W = 248.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0204
```

Standard Normal Distribution

P(0 ≤ Z ≤ z)

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

Student's t distribution

	Probabilities to the right										
d.f.	0.250	0.200	0.150	**0.100**	0.075	**0.050**	0.030	**0.025**	**0.010**	**0.005**	**0.001**
1	1.00	1.38	1.96	3.08	4.17	6.31	10.58	12.71	31.82	63.66	318.31
2	0.82	1.06	1.39	1.89	2.28	2.92	3.90	4.30	6.96	9.92	22.33
3	0.76	0.98	1.25	1.64	1.92	2.35	2.95	3.18	4.54	5.84	10.21
4	0.74	0.94	1.19	1.53	1.78	2.13	2.60	2.78	3.75	4.60	7.17
5	0.73	0.92	1.16	1.48	1.70	2.02	2.42	2.57	3.36	4.03	5.89
6	0.72	0.91	1.13	1.44	1.65	1.94	2.31	2.45	3.14	3.71	5.21
7	0.71	0.90	1.12	1.41	1.62	1.89	2.24	2.36	3.00	3.50	4.79
8	0.71	0.89	1.11	1.40	1.59	1.86	2.19	2.31	2.90	3.36	4.50
9	0.70	0.88	1.10	1.38	1.57	1.83	2.15	2.26	2.82	3.25	4.30
10	0.70	0.88	1.09	1.37	1.56	1.81	2.12	2.23	2.76	3.17	4.14
11	0.70	0.88	1.09	1.36	1.55	1.80	2.10	2.20	2.72	3.11	4.02
12	0.70	0.87	1.08	1.36	1.54	1.78	2.08	2.18	2.68	3.05	3.93
13	0.69	0.87	1.08	1.35	1.53	1.77	2.06	2.16	2.65	3.01	3.85
14	0.69	0.87	1.08	1.35	1.52	1.76	2.05	2.14	2.62	2.98	3.79
15	0.69	0.87	1.07	1.34	1.52	1.75	2.03	2.13	2.60	2.95	3.73
16	0.69	0.86	1.07	1.34	1.51	1.75	2.02	2.12	2.58	2.92	3.69
17	0.69	0.86	1.07	1.33	1.51	1.74	2.02	2.11	2.57	2.90	3.65
18	0.69	0.86	1.07	1.33	1.50	1.73	2.01	2.10	2.55	2.88	3.61
19	0.69	0.86	1.07	1.33	1.50	1.73	2.00	2.09	2.54	2.86	3.58
20	0.69	0.86	1.06	1.33	1.50	1.72	1.99	2.09	2.53	2.85	3.55
21	0.69	0.86	1.06	1.32	1.49	1.72	1.99	2.08	2.52	2.83	3.53
22	0.69	0.86	1.06	1.32	1.49	1.72	1.98	2.07	2.51	2.82	3.50
23	0.69	0.86	1.06	1.32	1.49	1.71	1.98	2.07	2.50	2.81	3.48
24	0.68	0.86	1.06	1.32	1.49	1.71	1.97	2.06	2.49	2.80	3.47
25	0.68	0.86	1.06	1.32	1.49	1.71	1.97	2.06	2.49	2.79	3.45
26	0.68	0.86	1.06	1.31	1.48	1.71	1.97	2.06	2.48	2.78	3.43
27	0.68	0.86	1.06	1.31	1.48	1.70	1.96	2.05	2.47	2.77	3.42
28	0.68	0.85	1.06	1.31	1.48	1.70	1.96	2.05	2.47	2.76	3.41
29	0.68	0.85	1.06	1.31	1.48	1.70	1.96	2.05	2.46	2.76	3.40

F-Table for alpha = 0.050

Den d.f.	Num d.f.									
	31	32	33	33	34	35	40	45	50	200
30	1.83	1.83	1.82	1.82	1.82	1.81	1.79	1.77	1.76	1.66
31	1.82	1.82	1.81	1.81	1.81	1.80	1.78	1.76	1.75	1.65
32	1.81	1.80	1.80	1.80	1.79	1.79	1.77	1.75	1.74	1.63
33	1.80	1.79	1.79	1.79	1.78	1.78	1.76	1.74	1.72	1.62
35	1.78	1.77	1.77	1.77	1.76	1.76	1.74	1.72	1.70	1.60
40	1.74	1.73	1.73	1.73	1.72	1.72	1.69	1.67	1.66	1.55
45	1.71	1.70	1.69	1.69	1.69	1.68	1.66	1.64	1.63	1.51
50	1.68	1.67	1.67	1.67	1.66	1.66	1.63	1.61	1.60	1.48
100	1.57	1.56	1.55	1.55	1.55	1.54	1.52	1.49	1.48	1.34
200	1.51	1.50	1.49	1.49	1.49	1.48	1.46	1.43	1.41	1.26