Economics 203B
Winter 2003
Midterm Examination
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You have 1 hour and 20 minutes to do the following three problems. Write carefully and clearly. Try to answer ALL questions as partial credit will be given. GOOD LUCK!

define things properly ✓ ✓ model

PROBLEM 1 (*35 points*):
You are hired as political analyst at a TV station. You are asked to present a study about how citizens voted at the last presidential elections. You have access to the percentage of votes per party, for the two parties, at a state level. You also know for each state whether the presidential candidate delivered a speech there within the last month before the elections or not.

(a) Describe a (linear) model of states' voting for a party based on the above information and your knowledge of the states' location.

(b) Describe how you would allow for potentially differential effects of whether the party's candidate campaigned in a state depending on the state's location (east, west, north, south).

(c) How would you test for the presence of such location effects? Be as precise as possible about the type of test and critical values you would use and why.

(d) Suppose that in addition you have access to the results of the previous presidential elections at a state level and you also know for each state whether the parties' leaders campaigned in that state or not during the last month before each election. Describe how you could use this additional information to improve your analysis of parts (a)-(c).

PROBLEM 2 (*50 points*):
Suppose that

$$y_i = x_i^\star \beta + \varepsilon_i$$

$$x_i = x_i^\star \cdot \nu_i$$

$$z_i = x_i^\star \cdot \eta_i$$

where $x_i^\star$, ε_i, ν_i and η_i are independent random variables and $(x_i^\star, \varepsilon_i, \nu_i, \eta_i)$ is independent and identically distributed over i.
You observe (y_i, x_i, z_i) for $i = 1, 2, \ldots n$, and you are interested in estimating β.
Answer the following questions under the assumption that all relevant moments exist.

10 (a) Under what conditions is the OLS estimator

$$\hat{\beta}_{\text{OLS}} = \frac{\sum_{i=1}^{n} y_i x_i}{\sum_{i=1}^{n} x_i^2}$$

consistent for β?

For the remaining questions assume that $E[\nu_i] = E[\eta_i] = 1$.

10 (b) Let α be a fixed real number between 0 and 1. Under what conditions is

$$\tilde{\beta} = \frac{\sum_{i=1}^{n} (\alpha y_i x_i + (1-\alpha) y_i z_i)}{\sum_{i=1}^{n} x_i z_i}$$

consistent?

5 (c) Derive the limiting distribution of $\sqrt{n}(\tilde{\beta} - \beta)$, where $\tilde{\beta}$ is defined in (b).

5 (d) What is the best choice of α?

In parts (c) and (d) assume that the conditions of part (b) hold so that $\tilde{\beta}$ is consistent.

PROBLEM 3 (*15 points*):
A regression model with $k = 16$ independent variables is fit using a panel of seven years of data. The sums of squares for the seven separate regressions and the pooled regression are shown below. The model with the pooled data allows a separate constant for each year. Test the hypothesis that the same coefficients apply in every year.

	1984	1985	1986	1987	1988	1989	1990	All Years
Observations	65	55	87	95	103	87	78	570
ESS ($\hat{\varepsilon}'\hat{\varepsilon}$)	104	88	206	144	199	308	211	1425

Make sure that you explain the test you preform, derive the distribution of the test statistic under the assumptions of the CNR model and justify the critical value you use.

$\Sigma(y - \bar{y})^2$

Appendix A
Statistical and Data Tables

Table A.1 Standard normal cumulative distribution function.

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.500	0.504	0.508	0.512	0.516	0.520	0.524	0.528	0.532	0.536
0.10	0.540	0.544	0.548	0.552	0.556	0.560	0.564	0.567	0.571	0.575
0.20	0.579	0.583	0.587	0.591	0.595	0.599	0.603	0.606	0.610	0.614
0.30	0.618	0.622	0.626	0.629	0.633	0.637	0.641	0.644	0.648	0.652
0.40	0.655	0.659	0.663	0.666	0.670	0.674	0.677	0.681	0.684	0.688
0.50	0.691	0.695	0.698	0.702	0.705	0.709	0.712	0.716	0.719	0.722
0.60	0.726	0.729	0.732	0.736	0.739	0.742	0.745	0.749	0.752	0.755
0.70	0.758	0.761	0.764	0.767	0.770	0.773	0.776	0.779	0.782	0.785
0.80	0.788	0.791	0.794	0.797	0.800	0.802	0.805	0.808	0.811	0.813
0.90	0.816	0.819	0.821	0.824	0.826	0.829	0.831	0.834	0.836	0.839
1.00	0.841	0.844	0.846	0.848	0.851	0.853	0.855	0.858	0.860	0.862
1.10	0.864	0.867	0.869	0.871	0.873	0.875	0.877	0.879	0.881	0.883
1.20	0.885	0.887	0.889	0.891	0.893	0.894	0.896	0.898	0.900	0.901
1.30	0.903	0.905	0.907	0.908	0.910	0.911	0.913	0.915	0.916	0.918
1.40	0.919	0.921	0.922	0.924	0.925	0.926	0.928	0.929	0.931	0.932
1.50	0.933	0.934	0.936	0.937	0.938	0.939	0.941	0.942	0.943	0.944
1.60	0.945	0.946	0.947	0.948	0.949	0.951	0.952	0.953	0.954	0.954
1.70	0.955	0.956	0.957	0.958	0.959	0.960	0.961	0.962	0.962	0.963
1.80	0.964	0.965	0.966	0.966	0.967	0.968	0.969	0.969	0.970	0.971
1.90	0.971	0.972	0.973	0.973	0.974	0.974	0.975	0.976	0.976	0.977
2.00	0.977	0.978	0.978	0.979	0.979	0.980	0.980	0.981	0.981	0.982
2.10	0.982	0.983	0.983	0.983	0.984	0.984	0.985	0.985	0.985	0.986
2.20	0.986	0.986	0.987	0.987	0.987	0.988	0.988	0.988	0.989	0.989
2.30	0.989	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.992
2.40	0.992	0.992	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.994
2.50	0.994	0.994	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995
2.60	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
2.70	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
2.80	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998
2.90	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.999	0.999
3.00	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999

Example: If $Z \sim N(0, 1)$, then $\Pr(Z \leq 1.15) = F(1.15) = 0.875$.

Table A.2 Chi-square cumulative distribution function.

	$G_k(\cdot)$										
k	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55
1	0.00	0.02	0.04	0.06	0.10	0.15	0.21	0.27	0.36	0.45	0.57
2	0.10	0.21	0.33	0.45	0.58	0.71	0.86	1.02	1.20	1.39	1.60
3	0.35	0.58	0.80	1.01	1.21	1.42	1.64	1.87	2.11	2.37	2.64
4	0.71	1.06	1.37	1.65	1.92	2.19	2.47	2.75	3.05	3.36	3.69
5	1.15	1.61	1.99	2.34	2.67	3.00	3.33	3.66	4.00	4.35	4.73
6	1.64	2.20	2.66	3.07	3.45	3.83	4.20	4.57	4.95	5.35	5.77
7	2.17	2.83	3.36	3.82	4.25	4.67	5.08	5.49	5.91	6.35	6.80
8	2.73	3.49	4.08	4.59	5.07	5.53	5.98	6.42	6.88	7.34	7.83
9	3.33	4.17	4.82	5.38	5.90	6.39	6.88	7.36	7.84	8.34	8.86
10	3.94	4.87	5.57	6.18	6.74	7.27	7.78	8.30	8.81	9.34	9.89
11	4.57	5.58	6.34	6.99	7.58	8.15	8.70	9.24	9.78	10.34	10.92
12	5.23	6.30	7.11	7.81	8.44	9.03	9.61	10.18	10.76	11.34	11.95
13	5.89	7.04	7.90	8.63	9.30	9.93	10.53	11.13	11.73	12.34	12.97
14	6.57	7.79	8.70	9.47	10.17	10.82	11.45	12.08	12.70	13.34	14.00
15	7.26	8.55	9.50	10.31	11.04	11.72	12.38	13.03	13.68	14.34	15.02
16	7.96	9.31	10.31	11.15	11.91	12.62	13.31	13.98	14.66	15.34	16.04
17	8.67	10.09	11.12	12.00	12.79	13.53	14.24	14.94	15.63	16.34	17.06
18	9.39	10.86	11.95	12.86	13.68	14.44	15.17	15.89	16.61	17.34	18.09
19	10.12	11.65	12.77	13.72	14.56	15.35	16.11	16.85	17.59	18.34	19.11
20	10.85	12.44	13.60	14.58	15.45	16.27	17.05	17.81	18.57	19.34	20.13
25	14.61	16.47	17.82	18.94	19.94	20.87	21.75	22.62	23.47	24.34	25.22
30	18.49	20.60	22.11	23.36	24.48	25.51	26.49	27.44	28.39	29.34	30.31
35	22.47	24.80	26.46	27.84	29.05	30.18	31.25	32.28	33.31	34.34	35.39
40	26.51	29.05	30.86	32.34	33.66	34.87	36.02	37.13	38.23	39.34	40.46
45	30.61	33.35	35.29	36.88	38.29	39.58	40.81	42.00	43.16	44.34	45.53
50	34.76	37.69	39.75	41.45	42.94	44.31	45.61	46.86	48.10	49.33	50.59
55	38.96	42.06	44.24	46.04	47.61	49.06	50.42	51.74	53.04	54.33	55.65
60	43.19	46.46	48.76	50.64	52.29	53.81	55.24	56.62	57.98	59.33	60.71
65	47.45	50.88	53.29	55.26	56.99	58.57	60.07	61.51	62.92	64.33	65.77
70	51.74	55.33	57.84	59.90	61.70	63.35	64.90	66.40	67.87	69.33	70.82
75	56.05	59.79	62.41	64.55	66.42	68.13	69.74	71.29	72.81	74.33	75.88
80	60.39	64.28	66.99	69.21	71.14	72.92	74.58	76.19	77.76	79.33	80.93
85	64.75	68.78	71.59	73.88	75.88	77.71	79.43	81.09	82.71	84.33	85.98
90	69.13	73.29	76.20	78.56	80.62	82.51	84.29	85.99	87.67	89.33	91.02
95	73.52	77.82	80.81	83.25	85.38	87.32	89.14	90.90	92.62	94.33	96.07
100	77.93	82.36	85.44	87.95	90.13	92.13	94.00	95.81	97.57	99.33	101.11

Example: If $W \sim \chi^2(6)$, then $\Pr(W \leq 4.20) = G_6(4.20) = 0.35$.

Table A.2 (continued)

	$G_k(\cdot)$										
k	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	0.975	0.990	0.995
1	0.71	0.87	1.07	1.32	1.64	2.07	2.71	3.84	5.02	6.63	7.88
2	1.83	2.10	2.41	2.77	3.22	3.79	4.61	5.99	7.38	9.21	10.60
3	2.95	3.28	3.66	4.11	4.64	5.32	6.25	7.81	9.35	11.34	12.84
4	4.04	4.44	4.88	5.39	5.99	6.74	7.78	9.49	11.14	13.28	14.86
5	5.13	5.57	6.06	6.63	7.29	8.12	9.24	11.07	12.83	15.09	16.75
6	6.21	6.69	7.23	7.84	8.56	9.45	10.64	12.59	14.45	16.81	18.55
7	7.28	7.81	8.38	9.04	9.80	10.75	12.02	14.07	16.01	18.48	20.28
8	8.35	8.91	9.52	10.22	11.03	12.03	13.36	15.51	17.53	20.09	21.95
9	9.41	10.01	10.66	11.39	12.24	13.29	14.68	16.92	19.02	21.67	23.59
10	10.47	11.10	11.78	12.55	13.44	14.53	15.99	18.31	20.48	23.21	25.19
11	11.53	12.18	12.90	13.70	14.63	15.77	17.28	19.68	21.92	24.72	26.76
12	12.58	13.27	14.01	14.85	15.81	16.99	18.55	21.03	23.34	26.22	28.30
13	13.64	14.35	15.12	15.98	16.98	18.20	19.81	22.36	24.74	27.69	29.82
14	14.69	15.42	16.22	17.12	18.15	19.41	21.06	23.68	26.12	29.14	31.32
15	15.73	16.49	17.32	18.25	19.31	20.60	22.31	25.00	27.49	30.58	32.80
16	16.78	17.56	18.42	19.37	20.47	21.79	23.54	26.30	28.85	32.00	34.27
17	17.82	18.63	19.51	20.49	21.61	22.98	24.77	27.59	30.19	33.41	35.72
18	18.87	19.70	20.60	21.60	22.76	24.16	25.99	28.87	31.53	34.81	37.16
19	19.91	20.76	21.69	22.72	23.90	25.33	27.20	30.14	32.85	36.19	38.58
20	20.95	21.83	22.77	23.83	25.04	26.50	28.41	31.41	34.17	37.57	40.00
25	26.14	27.12	28.17	29.34	30.68	32.28	34.38	37.65	40.65	44.31	46.93
30	31.32	32.38	33.53	34.80	36.25	37.99	40.26	43.77	46.98	50.89	53.67
35	36.47	37.62	38.86	40.22	41.78	43.64	46.06	49.80	53.20	57.34	60.27
40	41.62	42.85	44.16	45.62	47.27	49.24	51.81	55.76	59.34	63.69	66.77
45	46.76	48.06	49.45	50.98	52.73	54.81	57.51	61.66	65.41	69.96	73.17
50	51.89	53.26	54.72	56.33	58.16	60.35	63.17	67.50	71.42	76.15	79.49
55	57.02	58.45	59.98	61.66	63.58	65.86	68.80	73.31	77.38	82.29	85.75
60	62.13	63.63	65.23	66.98	68.97	71.34	74.40	79.08	83.30	88.38	91.95
65	67.25	68.80	70.46	72.28	74.35	76.81	79.97	84.82	89.18	94.42	98.11
70	72.36	73.97	75.69	77.58	79.71	82.26	85.53	90.53	95.02	100.43	104.21
75	77.46	79.13	80.91	82.86	85.07	87.69	91.06	96.22	100.84	106.39	110.29
80	82.57	84.28	86.12	88.13	90.41	93.11	96.58	101.88	106.63	112.33	116.32
85	87.67	89.43	91.32	93.39	95.73	98.51	102.08	107.52	112.39	118.24	122.32
90	92.76	94.58	96.52	98.65	101.05	103.90	107.57	113.15	118.14	124.12	128.30
95	97.85	99.72	101.72	103.90	106.36	109.29	113.04	118.75	123.86	129.97	134.25
100	102.95	104.86	106.91	109.14	111.67	114.66	118.50	124.34	129.56	135.81	140.17