# Final Exam
Quantitative Methods

December 2004

1. Can a title help you understand a text? To address this question, a researcher examined reading comprehension (i.e., how many of the key facts were understood) in subjects who read two different texts, one with a title and one without a title. Subjects read one text and then took a comprehension test on this text; then they read the second text and took a comprehension test. One of the texts had a title and the other was did not (the researcher counterbalanced this factor.) The scores of the comprehension test are as follows. (Higher comprehension scores indicate better comprehension or understanding.)

Subject	With Title	Without Title
1	52	48
2	56	55
3	45	46
4	35	30
5	22	15
6	48	40
	43	39

Does having a title make a text significantly easier to comprehend?

(a) Describe concisely the type of design used.

(b) Give the model assuming no interaction between the block and the treatment effects.

(c) What is the hypothesis of interest? State this hypothesis and its alternate in terms of the parameters from the model, the ANOVA table, the (approximate) p-value, and the conclusion.

(d) If one do not take into account the block effects in the analysis, what will be the conclusion. Discuss briefly the result.

2. A researcher investigates sleepiness ratings for people who work from 9am - 5pm and for shift workers (who have rotating schedules). The results are in the following graph :
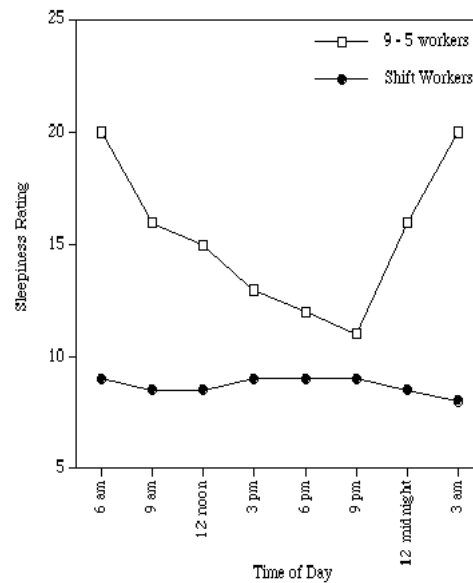
Interpret the main effects and interactions in these graphs. Also be able to report the type of design (e.g., $2 \times 2, 2 \times 4$, etc.) and give the model you should use for a quantitative analysis.

3. Based on 1500 interviews of American adults, 28% of those interviewed oppose capital punishment.

(a) Build a 95% confidence interval for the percentage p of all American adults that oppose capital punishment.

(b) Which value would you be willing to believe for p : 20%, 30% or 95%.

(c) From the results obtained in the previous survey, evaluate the required sample size to be 95% confident that p is included in the interval $[28\% \pm 2\%]$.

4. A population of $M = 3000$ households consists of $N = 10000$ persons and we require to estimate the total number of males τ by taking a

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simple random sample of $m = 30$ households and observing the number of males (y_i) and the number of persons N_i for each sampled household i.

(a) Calculate a 95% confidence intervals for τ based on the data in the Table.

Household composition by sex $(m = 30)$												
Number of persons (N_i)	Number of Males (y_i)											
1	0											
2	1	1	1	1								
3	1	1	1	1	1	1	1	2	2	2	2	2
4	1	2	2	2	3	3	3	3	3			
5	1	3										
6	3											
7	3											

(b) Compare the interval with what would have been obtained if the 104 individuals in the sample had in fact been selected randomly from the population of 10000 individuals. Discuss briefly the result.

5. **Extra Credit :** A social research scientist wants to test whether the percentage of Republicans who favor the death penalty is greater than the percentage of Democrats who are in favor of the death penalty. Suppose the sample data showed that the percentage of Republicans who are in favor of the death penalty is 42% and the percentage of Democrats who are in favor of the death penalty is 40%. The p-value for this test is .0021. The 95% confidence interval for $p_1 - p_2$ is $[.00637, .03363]$. Which of the following conclusions do you think is more appropriate to draw ?

(a) There is evidence of a large difference in the two proportions.

(b) There is strong evidence of a difference in the two proportions.

TABLE VI
Values of F_α
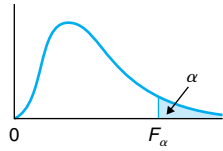
dfd	α	dfn 1	2	3	4	5	6	7	8	9
	0.10	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86
	0.05	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54
1	0.025	647.79	799.50	864.16	899.58	921.85	937.11	948.22	956.66	963.28
	0.01	4052.2	4999.5	5403.4	5624.6	5763.6	5859.0	5928.4	5981.1	6022.5
	0.005	16211	20000	21615	22500	23056	23437	23715	23925	24091
	0.10	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38
	0.05	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
2	0.025	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37	39.39
	0.01	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39
	0.005	198.50	199.00	199.17	199.25	199.30	199.33	199.36	199.37	199.39
	0.10	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24
	0.05	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
3	0.025	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54	14.47
	0.01	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35
	0.005	55.55	49.80	47.47	46.19	45.39	44.84	44.43	44.13	43.88
	0.10	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94
	0.05	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
4	0.025	12.22	10.65	9.98	9.60	9.36	9.20	9.07	8.98	8.90
	0.01	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66
	0.005	31.33	26.28	24.26	23.15	22.46	21.97	21.62	21.35	21.14
	0.10	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32
	0.05	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
5	0.025	10.01	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68
	0.01	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16
	0.005	22.78	18.31	16.53	15.56	14.94	14.51	14.20	13.96	13.77
	0.10	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96
	0.05	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
6	0.025	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52
	0.01	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98
	0.005	18.63	14.54	12.92	12.03	11.46	11.07	10.79	10.57	10.39
	0.10	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72
	0.05	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
7	0.025	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90	4.82
	0.01	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
	0.005	16.24	12.40	10.88	10.05	9.52	9.16	8.89	8.68	8.51
	0.10	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56
	0.05	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
8	0.025	7.57	6.06	5.42	5.05	4.82	4.65	4.53	4.43	4.36
	0.01	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
	0.005	14.69	11.04	9.60	8.81	8.30	7.95	7.69	7.50	7.34