STATISTICS MASTER'S/PH.D. QUALIFYING EXAM: Take-home Portion
Handed out August 12, 2002. Due: August 16, 2002 at noon.

DIRECTIONS: Turn in your answers by noon on Friday, August 16, 2002, to the main office or to the proctor of the exam. Answer each question in two or less typed pages; you are encouraged to create a brief, well-organized appendix for each answer. You are to work on the exam independently.

1. **Galapagos Islands Diversity:** The Galapagos Islands off the coast of Ecuador provide an excellent laboratory for studying the factors that influence the development and survival of different life species. Johnson and Raven (1973; Science p893-5) have presented the data below giving the number of species and related variables for 29 different islands. Counts are given both for the total number of species and the number of species that occur only on that one island (the endemics).

   Use these data to find factors that seem to influence diversity, as measured by the ratio of the number of endemics divided by the number of species, and summarize your results.

   One complicating factor is that the elevation is not recorded for 6 small islands [the . in data], so some provision must be made for this. Four possibilities are (1) find the elevations (2) delete these islands (3) ignore elevation as a potential predictor (4) substitute a plausible value for the elevations. Other possibilities could be pursued as well. Large-scale maps do suggest that none of these elevations exceed 200m.

   The variables in the data set are, from left to right: number of species, endemics, area in km^2, elevation in m, distance from nearest island, distance from Santa Cruz, area of adjacent island in km^2, island name.

   The data may be found at **http://www.stat.unm.edu/~hanson/galap.txt**.

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 58 23   25.09    .  0.6   0.6    1.84  Baltra
 31 21    1.24  109  0.6  26.3  572.33  Bartolome
  3  3    0.21  114  2.8  58.7    0.78  Caldwell
 25  9    0.10   46  1.9  47.4    0.18  Champion
  2  1    0.05    .  1.9   1.9  903.82  Coamano
 18 11    0.34    .  8.0   8.0    1.84  Daphne Major
 10  7    2.33  168 34.1 290.2    2.85  Darwin
  8  4    0.03    .  0.4   0.4   17.95  Eden
  2  2    0.18  112  2.6  50.2    0.10  Enderby
 97 26   58.27  198  1.1  88.3    0.57  Espanola
 93 35  634.49 1494  4.3  95.3 4669.32  Fernandina
 58 17    0.57   49  1.1  93.1   58.27  Gardner (near Espanola)
  5  4    0.78  227  4.6  62.2    0.21  Gardner (near Santa Maria)
 40 19   17.35   76 47.4  92.2  129.49  Genovesa
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347	89	4669.32	1707	0.7	28.1	634.49	Isabela
51	23	129.49	343	29.1	85.9	59.56	Marchena
2	2	0.01	25	3.3	45.9	0.10	Onslow
104	37	59.56	777	29.1	119.6	129.49	Pinta
108	33	17.95	458	10.7	10.7	0.03	Pinzon
12	9	0.23	.	0.5	0.6	25.09	Las Plazas
70	30	4.89	367	4.4	24.4	572.33	Rabida
280	65	551.62	716	45.2	66.5	0.57	San Cristobal
237	81	572.33	906	0.2	19.8	4.89	San Salvador
444	95	903.82	864	0.6	0.0	0.52	Santa Cruz
62	28	24.08	259	16.5	16.5	0.52	Santa Fe
285	73	170.92	640	2.6	49.2	0.10	Santa Maria
44	16	1.84	.	0.6	9.6	25.09	Seymour
16	8	1.24	186	6.8	50.9	17.95	Tortuga
21	12	2.85	253	34.1	254.7	2.33	Wolf

2. **Blood Pressure in Rabbits:** A laboratory experiment was set up to investigate the relationship between drug dosage and mean diastolic blood pressure. Twelve rabbits received six different dose levels of the drug in random order, with a large time lapse between doses. The following table gives the increase from baseline in diastolic blood pressure Y_{ij} for rabbit i and drug dosage j. The index $j = 1, 2, 3, 4, 5, 6$ corresponds to doses $0.1, 0.3, 0.5, 1.0, 1.5, 3.0$ respectively. The data follow.

Incr.	Rabbit	Dose	Incr.	Rabbit	Dose	Incr.	Rabbit	Dose
21.0	1	1	21.0	1	2	23.0	1	3
35.0	1	4	36.0	1	5	48.0	1	6
19.0	2	1	24.0	2	2	27.0	2	3
36.0	2	4	36.0	2	5	46.0	2	6
12.0	3	1	25.0	3	2	27.0	3	3
26.0	3	4	33.0	3	5	40.0	3	6
9.0	4	1	17.0	4	2	18.0	4	3
27.0	4	4	34.0	4	5	39.0	4	6
7.0	5	1	10.0	5	2	19.0	5	3
25.0	5	4	31.0	5	5	38.0	5	6
18.0	6	1	26.0	6	2	26.0	6	3
29.0	6	4	39.0	6	5	44.0	6	6
9.0	7	1	12.0	7	2	17.0	7	3
22.0	7	4	33.0	7	5	40.0	7	6
20.0	8	1	20.0	8	2	30.0	8	3
30.0	8	4	38.0	8	5	41.0	8	6
18.0	9	1	18.0	9	2	27.0	9	3
31.0	9	4	42.0	9	5	49.0	9	6
8.0	10	1	12.0	10	2	11.0	10	3
24.0	10	4	26.0	10	5	31.0	10	6
18.0	11	1	22.0	11	2	25.0	11	3
32.0	11	4	38.0	11	5	38.0	11	6
17.0	12	1	23.0	12	2	26.0	12	3
28.0	12	4	34.0	12	5	35.0	12	6

You are to provide a complete analysis of this data set, keeping in mind the goal of the experiment and the experimental design used in collecting data. In your appendix, you should provide appropriate residual plots and diagnostics with interpretation to convince a reader that their is no gross deficiencies in the assumptions for the statistical model you select. You may want consider the use of Tukey's test for additivity, if appropriate, as well as determining and analyzing contrasts of interest.

The data may be found at **http://www.stat.unm.edu/~hanson/rabbits.txt**.