BLOOD-BRAIN BARRIER EXPERIMENT

5. Describing the Relationships between Variables

5.1 Describing the antibody concentration ratio over sacrifice time levels by the treatment given.
5.2 Correlation matrix

5.1 The *Compare Means* procedure in SPSS was used to obtain the following output:

	STATISTICS FOR RATIO	SACRIFICE TIME (HOURS)			
		0.5		3	
		BD	NS	BD	NS
CENTER	MEAN	3.325E-2	1.399E-2	.1036	3.989E-2
	MEDIAN	2.821E-2	1.410E-2	.1090	3.671E-2
SPREAD	STANDARD DEV.	1.850E-2	2.956E-3	2.178E-2	7.733E-3
	STD ERROR	8.273E-3	1.478E-3	1.089E-2	3.458E-3
	VARIANCE	3.422E-4	8.735E-6	4.745E-4	5.980E-5
	MINIMUM	0.1	0.1	.07	0.3
	MAXIMUM	0.6	0.2	.12	0.5
	RANGE	0.5	0.1	.05	0.2
SHAPE	SKEWNESS	1.513	-.217	-1.178	1.470
	KURTOSIS	3.169	1.486	.939	1.999
	ST. ERROR KURT	2.000	2.619	2.619	2.000
COUNT		5	4	4	5

	STATISTICS FOR RATIO	SACRIFICE TIME (HOURS)			
		24		72	
		BD	NS	BD	NS
CENTER	MEAN	2.0628	1.1301	5.9088	3.4701
	MEDIAN	1.9569	.9263	6.1237	3.3671
SPREAD	STANDARD DEV.	.9227	.4943	2.6831	2.8215
	STD ERROR	.4613	.2472	1.3416	1.4108
	VARIANCE	.851	.244	7.199	7.961
	MINIMUM	1.07	.80	2.84	.41
	MAXIMUM	3.27	1.87	8.55	6.73
	RANGE	2.20	1.07	5.70	6.32
SHAPE	SKEWNESS	.623	1.912	1.585	2.269
	KURTOSIS	.650	3.739	1.689	4.839
	ST. ERROR KURT	2.619	2.619	1.063	1.063
COUNT		4	4	4	4

As you can see the average antibody concentration ratio increases as the sacrifice time increases. The average for the rats treated with BD is approximately twice that large as the average for the rats treated with the control solution. Moreover, the variation in the antibody concentration ratio also increases as the sacrifice time increases.

5.2 Examining the array of all possible pairwise correlation coefficients is the first step in attempting to understand the multivariable relationships among these nine variables. The correlation matrix (Pearson coefficient) for the variables in the study is displayed below:

	RATIO	TIME	TREAT	DAYS	SEX	WEIGHT	LOSS	TUMOR
RATIO	**1.000**	**.810**	**.176**	**.382**	**.336**	**.199**	**.125**	**.173**
RATIO	**1.000**	**.810**	**.176**	**.382**	**.336**	**.199**	**.125**	**.173**
	.	.000	.321	.026	.052	.258	.480	.328
	.	.000	.321	.026	.052	.258	.480	.328
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
TIME	**.810**	**1.000**	**-.003**	**.365**	**.479**	**.304**	**.210**	**.235**
TIME	**.810**	**1.000**	**-.003**	**.365**	**.479**	**.304**	**.210**	**.235**
	.000	.	.988	.034	.004	.081	.234	.182
	.000	.	.988	.034	.004	.081	.234	.182
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
TREAT	**.176**	**-.003**	**1.000**	**.065**	**.000**	**.043**	**-.072**	**-.251**
TREAT	**.176**	**-.003**	**1.000**	**.065**	**.000**	**.043**	**-.072**	**-.251**
	.321	.988	.	.715	1.000	.807	.684	.152
	.321	.988	.	.715	1.000	.807	.684	.152
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
DAYS	**.382**	**.365**	**.065**	**1.000**	**-.036**	**-.179**	**-.055**	**.070**
DAYS	**.382**	**.365**	**.065**	**1.000**	**-.036**	**-.179**	**-.055**	**.070**
	.026	.034	.715	.	.840	.311	.757	.693
	.026	.034	.715	.	.840	.311	.757	.693
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
SEX	**.336**	**.479**	**.000**	**-.036**	**1.000**	**.588**	**.048**	**.318**
SEX	**.336**	**.479**	**.000**	**-.036**	**1.000**	**.588**	**.048**	**.318**
	.052	.004	1.000	.840	.	.000	.787	.067
	.052	.004	1.000	.840	.	.000	.787	.067
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
WEIGHT	**.199**	**.304**	**.043**	**-.179**	**.588**	**1.000**	**.176**	**.166**
WEIGHT	**.199**	**.304**	**.043**	**-.179**	**.588**	**1.000**	**.176**	**.166**
	.258	.081	.807	.311	.000	.	.320	.348
	.258	.081	.807	.311	.000	.	.320	.348
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
LOSS	**.125**	**.210**	**-.072**	**-.055**	**.048**	**.176**	**1.000**	**.452**
LOSS	**.125**	**.210**	**-.072**	**-.055**	**.048**	**.176**	**1.000**	**.452**
	.480	.234	.684	.757	.787	.320	.	.007
	.480	.234	.684	.757	.787	.320	.	.007
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
TUMOR	**.173**	**.235**	**-.251**	**.070**	**.318**	**.166**	**.452**	**1.000**
TUMOR	**.173**	**.235**	**-.251**	**.070**	**.318**	**.166**	**.452**	**1.000**
	.328	.182	.152	.693	.067	.348	.007	.
	.328	.182	.152	.693	.067	.348	.007	.

The heighest correlation (r=0.810) is, not surprisingly, between antibody concentration ratio (RATIO) and sacrifice time (TIME). The array also shows that the covariates-days of inoculation, initial weight, and sex of the rat-are associated with the response. These covariates are also related to the treatment given. In particular, rats treated at longer days after inoculation were also assigned to the

longer sacrifice times. Moreover, the correlation coefficient of 0.479 between sacrifice time and sex, confirms that male rats tend to be assigned to the longer sacrifice times/

The graphical tools considered in Section 4 showed that there exists a strong linear relationship between the log transformed antibody concentration ratio and the logarithm of the sacrifice time. Let us look at the correlation matrix for the log transformed variables. In the matrix LNRATIO is the natural logarithm of the antibody concentration ratio, LNTIME is the natural logarithm of the sacrifice time.

	LNRATIO	LNTIME	LNTIMTRE	TREAT	DAYS	LOSS	SEX	TUMOR
LNRATIO	**1.000**	**.943**	**.658**	**.165**	**.397**	**.034**	**.561**	**.220**
LNRATIO	**1.000**	**.943**	**.658**	**.165**	**.397**	**.034**	**.561**	**.220**
	.	.000	.000	.352	.020	.850	.001	.211
	.	.000	.000	.352	.020	.850	.001	.211
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
LNTIME	**.943**	**1.000**	**.591**	**-.028**	**.331**	**.095**	**.541**	**.225**
LNTIME	**.943**	**1.000**	**.591**	**-.028**	**.331**	**.095**	**.541**	**.225**
	.000	.	.000	.877	.056	.595	.001	.201
	.000	.	.000	.877	.056	.595	.001	.201
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
LNTIMTRE	**.658**	**.591**	**1.000**	**.547**	**.214**	**.017**	**.322**	**-.099**
LNTIMTRE	**.658**	**.591**	**1.000**	**.547**	**.214**	**.017**	**.322**	**-.099**
	.000	.000	.	.001	.224	.923	.063	.578
	.000	.000	.	.001	.224	.923	.063	.578
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
TREAT	**.165**	**-.028**	**.547**	**1.000**	**.065**	**-.072**	**.000**	**-.251**
TREAT	**.165**	**-.028**	**.547**	**1.000**	**.065**	**-.072**	**.000**	**-.251**
	.352	.877	.001	.	.715	.684	1.000	.152
	.352	.877	.001	.	.715	.684	1.000	.152
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
DAYS	**.397**	**.331**	**.214**	**.065**	**1.000**	**-.055**	**-.036**	**.070**
DAYS	**.397**	**.331**	**.214**	**.065**	**1.000**	**-.055**	**-.036**	**.070**
	.020	.056	.224	.715	.	.757	.840	.693
	.020	.056	.224	.715	.	.757	.840	.693
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
LOSS	**.034**	**.095**	**.017**	**-.072**	**-.055**	**1.000**	**.048**	**.452**
LOSS	**.034**	**.095**	**.017**	**-.072**	**-.055**	**1.000**	**.048**	**.452**
	.850	.595	.923	.684	.757	.	.787	.007
	.850	.595	.923	.684	.757	.	.787	.007
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
SEX	**.561**	**.541**	**.322**	**.000**	**-.036**	**.048**	**1.000**	**.318**
SEX	**.561**	**.541**	**.322**	**.000**	**-.036**	**.048**	**1.000**	**.318**
	.001	.001	.063	1.000	.840	.787	.	.067
	.001	.001	.063	1.000	.840	.787	.	.067
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34
TUMOR	**.220**	**.225**	**-.099**	**-.251**	**.070**	**.452**	**.318**	**1.000**
TUMOR	**.220**	**.225**	**-.099**	**-.251**	**.070**	**.452**	**.318**	**1.000**
	.211	.201	.578	.152	.693	.007	.067	.
	.211	.201	.578	.152	.693	.007	.067	.
	34	34	34	34	34	34	34	34
	34	34	34	34	34	34	34	34

The high correlation between LNRATIO and LNTIME support the conclusion about the strong linear relationship between the two variables reached with the scatterplot. The correlation coefficient of 0.541 between SEX and LNTIME expresses the fact that male rats tend to be assigned to the longer sacrifice times.