Psychology 5741: Quantitative Methods in Neuroscience
Lab Exercise: GLM

Instructions: These data sets use various forms of the GLM—t tests, regression, ANOVA, and ANCOVA. There can be several different ways to solve the same problem.

Data Set: Kindling

Background: To examine recovery from brain injury, anesthetized rats were given unilateral cortical lesions followed by implantation of an electrode in the amygdala ipsilateral or contralateral to the lesion. After recovery rats were divided into three groups and given either: (1) no kindling, (2) State 0 kindling (a single stimulation to the amygdala every day), or (3) State 1 kindling (three simulations on day 1, two on day 2, and one thereafter). Rats were sacrificed and immunohistochemistry was used to assay for the amount of c-fos in the piriform cortex.

Your Task: Write up the results.


Data Set: ge_interaction

Background: Transgenic mice were created that differed in the number of a specific type of serotonin receptor concentrated in a region of the brain. Genotype aa had few receptors, genotype Aa had a moderate amount of receptors, and genotype AA had number receptors. Mice were raised in either of two conditions. The first, termed normal here, was ordinary rearing in home cages. The second, termed enriched, involved colony living in a large room. Mice were then tested on several learning tasks from which a composite “learning index,” was derived. Higher scores on this index are indicative of faster learning.

Your Task: Perform a traditional two way ANOVA on these data and write up the results. Then compare and contrast these results with linear and quadratic contrast coding of the genotype variable.

Based on: These are fictitious data, but the form of the results is very similar for empirical data in inbred strains of rats or mice under different rearing conditions.

Data Set: Audiogenic

Background: The overall purpose of this study was to examine behavioral, neuroendocrine, and regional brain activity following 30 minutes of white noise of different intensities. This data set gives measures of brain activity (c-fos levels) in eight areas of the hypothalamus. The variable “dB Sound” gives the sound level in decibels, the value of 0 denoting the controls without sound.
**Your Task:** This is a difficult exercise because there are several different correct ways to analyze these results. Choose one and write up the results. Be very careful of the initial scaling.


**Data Set: pkc-gamma**

**Background:** Protein kinase C (PKC) is major enzyme involved in the second messenger pathways of the post synaptic neuron. This data set investigates the role of the gene for the γ isoform of PKC on anxiety. There are three groups of mice. The first are “null mutants” (i.e., neither of their two alleles for PKCγ produces the enzyme); the second group are heterozygous (one good PKCγ allele along with one that does not produce the enzyme), and the final group are homozygous wild type (two good PKCγ alleles). The dependent variable is the percent of time in an elevated plus-maze spent in the open arms.

**Your Task:** Analyze this using traditional ANOVA with post hoc tests and contrast coding. Write up the results, comparing the two methods.


**Data Sets: Cytokine Contextual and Cytokine Auditory**

**Background:** Cytokines are a class of immunological molecules that assist in the creation of fever, slow wave sleep, decreased activity, etc. that result after detection of foreign antigens. These two data sets investigate the effects of two doses of lipopolysaccharide (LPS) on memory for fear conditioning. LPS stimulates the immune system and is thought to do this through the action of the cytokine interleukin-1β.

The two data sets were gathered on two different sets of rats. Data set “Cytokine Contextual” involves contextual fear conditioning in which a rat is placed back into the same environment in which a defensive fear response was learned. This type of learning is dependent on the hippocampus. Data set “Cytokine Auditory” involves pairing of a tone and shock, a type of learning independent of the hippocampus. The purpose of this study was to test whether the immune system is selectively involved in hippocampal-dependent memory.

**Your Task:** Analyze this using traditional ANOVA with post hoc tests and contrast coding. Write up the results, comparing the two methods.

Data Set: Maze

**Background:** These are fictitious data that give the average number of errors over trials in a complex maze as a function of the genotype at a single locus in a heterogeneous population of rats. It is assumed that fewer errors denote better learning.

Data Set: Ages

**Background:** These are fictitious data giving the amount per volume of a peptide in a certain brain region as a function of the age of a rat.

Data Set: Drug Effects

**Background:** A new research compound (variable Anxiolytic in the data set) is suspected to have its anti-anxiety effect by acting as an agonist for a neurotransmitter at a specific receptor. A potent, high affinity blocker for that receptor is administered to test if it will remove the anxiolytic effect of the new compound. The design is a two-by-two ANOVA with a behavioral measure of anxiety as the dependent variable. (High scores are associated with high anxiety.)

Data Set: Vasopressin

**Background:** Evidence suggests that the peptide vasopressin and its neural receptors are involved in sociality of the prairie vole. To examine the relative role of vasopressin versus the vasopressin receptors, transgenic mice were bred that had several sections of prairie vole vaspopressin receptor DNA integrated into their genome. Transgenic mice along with controls were then administered vehicle or vasopressin. The dependent variable is a measure of sociality in the mouse.  
Based on: Tom Insel

Data Set: Vigabatrin

**Background:** Drugs such as phenobarbitol and the benzodiazepines may inhibit recovery from some forms of brain damage when they are administered after a lesion is produced. The mechanism of action is thought to be related to the increase in the neurotransmitter GABA (gamma-aminobutyric acid). The present study addressed the effect of vigabatrin (a GABA agonist with a different mode of action than either the benzos or phenobarbitol) on recovery from a unilateral lesion to the anteromedial cortex (AMC).

All rats were lesioned using implanted electrodes and then kindled for seven days by stimulating the ipsilateral amygdala. Rats were randomly administered vehicle or 150, 200, or 250 mg/kg of vigabatrin. Half the animals were administered the solution before kindling and half after kindling. The dependent variable is a measure of somatosensory asymmetry (scores on the lesioned side less scores on the nonlesioned side). Scores of 0 denote perfect symmetry of response while positive scores denote impaired recovery from the lesion.
Based on: Mike Marks paper from Al Collins lab.

**Data Set: Inhibitor**
**Background:** Fictitious data testing the hypothesis that a drug (variable Inhibitor in the data set) will eliminate a well establish dose response relationship between another drug and a behavioral response.

**Data Set: Drug1_Drug2**
**Background:** Fictitious data based on an infusion experiment. Here a cannula is surgically implanted into the jugular vein of rats and combinations of two drugs (simply called Drug1 and Drug2 in the data set) are slowly infused. The two continuous variables are measures of electrophysiological activity in a brain area before and after the infusion.

**Data Set: Side Effects**
**Background:** This data set provides ratings on the side effects for doses within the therapeutic range for two antidepressant medications. Be careful because the doses for the two medications are different.

**Data Set: Lactate1**
**Background:** Intravenous injections of sodium lactate induce anxiety attacks in individuals susceptible to panic disorder. The present data are from a pilot study to test (1) whether intraperitoneal injections of sodium lactate will increase anxiety in mice and (2) whether inbred mouse strains are differentially sensitive to the lactate. The dependent variable is (150 – open field activity), so high scores denote greater anxiety.

**Data Set: Lactate2**
**Background:** This is a follow-up to the Lactate1 study described. The purpose is to establish dose-response curves to lactate in a sensitive strain (DBH) and in an insensitive strain (C57).