Problem Set 3

1. As part of your work with Idaho Fish and Game, you have been investigating the interaction between wolves and elk in the Selway Bitteroot Wilderness. Through a combination of arial surveys and radio collaring, you have been able to estimate the population size of wolves and elk in six independent river drainages. Your data is shown in the table below:

	Drainage					
	1	2	3	4	5	6
Wolves	12	3	18	0	6	2
Elk	287	345	134	156	234	178

Based on your data, does it appear that the population size of wolves and elk are correlated?

2. As part of your work with the Nez Perce Tribe, you have been tasked with evaluating the threat of extinction for steelhead living within tribal lands. Based on previous research, it is clear that the risk of extinction is critically dependent on the extent to which adult returns are correlated across two independent watersheds. The reason for this is that as long as one of these watersheds has good numbers of returning adults, the tribal hatchery has enough adult fish to rear a sufficient supply of juveniles for both watersheds. If, in contrast, both watersheds have poor adult returns in the same year, the tribal hatchery may not have enough adult fish to repopulate both watersheds with hatchery-reared juveniles. In order to evaluate the extent to which adult returns are correlated across these watersheds, you have collected historical return data from the past ten years:

	Adult Return by Year and Watershed									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
WS 1	76	45	23	89	136	123	45	36	9	28
WS 2	56	49	18	68	125	112	67	54	34	39

3. As part of your work with the USGS, your research team has been tasked with creating a distribution map for various amphibian species within the inland Northwest. Rather than travel to hundreds of locations and count amphibians at each, you are interested in trying to parameterize a linear model that forecasts how many frogs should be in any particular location based on the annual rainfall for that site. The beauty of this approach is that a very detailed map of annual rainfall already exists, so if your model works, you can predict where the amphibians live based on data that already exists. Changing temperature and frog abundance. You wish to use your linear model to predict how many frogs should be in each site. As a proof of concept, you have collected information on the density of one particular species of frog from 8 different sites for which you know annual rainfall:

	Annual rainfall and frog density by site							
	1	2	3	4	5	6	7	8
Rainfall (cm)	25.4	20	15	34	5	7	23	28
Frog density	123	117	67	145	0	4	98	129

Use this data and linear regression to develop a predictive model for frog density as a function of annual rainfall.

4. A new infectious disease has been identified and its R_0 calculated for the six different areas where it has been positively identified to date. In order to develop an effective risk management strategy, you are investigating the relationship between R_0 and human population density. Your hope is that by parameterizing a linear model that predicts R_0 based on population density, you will be able to forecast which locations are at risk of the disease spreading (those where $R_0 > 1$). The data collected to date from the six areas where the disease is now known to occur is shown in the table below.

	R_0 and human population density by region					
	1	2	3	4	5	6
R_0	0.46	1.34	1.13	0.78	0.57	1.04
Density	24.3	70.1	63.9	45.3	26.7	62.3

Use linear regression to develop a predictive model that forecasts the R_0 of the disease as a function of human population density.