

# **Kaitlyn Sanson**

Honors Thesis: students' perception on the mitigation of earthquake damage due to  
hydraulic fracturing  
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**Abstract**

This thesis' purpose was to find students' perceptions in the College of Agricultural Sciences and Natural Resources on earthquake liability due to hydraulic fracturing. Because there is not as much earthquake insurance offered for homeowners in the state of Oklahoma as there is for oil and natural gas companies I thought it would be interesting to see what students thought of the situation. There was a survey conducted in the Introduction to Agricultural Economics classes that evaluated those students' views on earthquakes liability. The data resulted in information regarding company and homeowner liability. After running regressions on the data and limiting my conclusion to what was statistically significant I found that there was a negative correlation between company liability and students that have families that work within the industry.

## **Introduction to Hydraulic Fracturing**

Hydraulic fracturing has become increasingly prevalent in Oklahoma over the past ten years. Hydraulic fracturing has increased the oil and gas production 73.3 percent within the past ten years (US Energy Information Administration). The United States Geological Survey defines hydraulic fracturing as “an oil and gas well development process that involves injecting water under high pressure into a bedrock formation.” The use of hydraulic fracturing has led to many impacts in the state of Oklahoma and surrounding areas.

There have been some laws and regulations set for hydraulic fracturing. The Department of Environmental Quality requires injection wells to regulate injection pressures, groundwater, solids and sludge (Title, 2002). The Department of Environmental Quality’s Underground Injection Control guidelines requires a pressure test every six months under ordinance 40 CFR 146.8(b) (2). The material injected is tested for signs of hazardous waste (Title, 2002). Oklahoma Governor Mary Fallin has signed Senate Bill 809, keeping town, city and county officials from banning hydraulic fracturing and other oilfield activities. The bill was drafted to prevent officials from limiting oil field operations in their area (Wertz & Layden, 2015). In June of 2015, the Oklahoma Supreme Court ruled that Oklahoma homeowners can now sue companies for property damage or injuries caused by hydraulic fracturing induced earthquakes, according to the New York Times.

Consumers of gasoline have seen the reduction of oil and gasoline prices as an effect of the supply and demand (Woodward). The cost of oil and gasoline prices also effects consumer welfare because the cost of getting places is more costly, as well as products on the store will increase due to their transportation costs increasing (Folger). Oklahoma passed a law in 1994 lowering the tax rate from 7 to 1 percent for oil and gas companies (Wertz). The state is giving large tax breaks to these companies that could be helping the economy in Oklahoma. Gas prices have dropped 47 percent since 2013 due to hydraulic fracturing because hydraulic fracturing enables oil and natural gas companies to extract more than they ever had, this causes a shift to the supply curve (Dews). Hydraulic fracturing also provides thousands of jobs and billions of dollars in gross state product (OERB, 2015). One-third of the state’s gross state product is provided by the oil and natural gas industry and so are one-fifth of the jobs (OERB, 2015).

Although there are positive impacts of hydraulic fracturing on Oklahoma’s economy, there are negative impacts environmentally. Five million barrels of shale gas are being produced a day (Kille, 2014). The hydraulic fracturing process uses about four million gallons of water for each injection site which can collect the chemicals used in the process (Loris, 2012). This water is not drinking water and follows both state and federal laws (Loris, 2012). One of the biggest complaints of hydraulic fracturing is in regards to the earthquakes that it causes. Some seismic activity has been linked to injection wells but not directly hydraulic fracturing (Loris, 2012).

## **Literature on Liability of Earthquake Damage**

Some insurance companies will cover pollution and physical damages to homes or property if the owner lives near a hydraulic fracturing site (Holbrook, 2014). Nationwide has issued a statement about their opinions on the insurance coverage of oil and natural gas

exploration. Because Nationwide cannot fully understand the risks associated with hydraulic fracturing they cannot cover homeowners at a reasonable price to match the risks associated with it (Nationwide, 2012). If the homeowner has an earthquake endorsement, an additional to their coverage policy, then they can receive coverage for earthquakes (Holbrook, 2014). The industry typically buys insurance to cover their well failures and third-party bodily injuries and property damages (NAIC, 2015). So it is much easier for the oil and natural gas industry to obtain insurance for hydraulic fracturing and hydraulic fracturing induced environmental causes than it is for homeowners to obtain insurance for these same issues.

## Methods

Since there is so much lacking in insurance policies for homeowners in terms of hydraulic fracturing I thought it would be interesting to survey students to find their opinions of liability for hydraulic fracturing. In order to find the perceptions from students about the mitigation of earthquake damage and hydraulic fracturing I created a survey. This survey was anonymous and given to three introduction to agricultural economics (AGEC 1113) classes. The following is a copy of the survey:

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The survey is conducted by an Oklahoma State University agribusiness student, Kaitlyn Sanson, as a research project.

This survey is being given to all students in AGECE 1113 sections. The purpose of this survey is to determine the student's perceptions about mitigation of earthquake damage and hydraulic fracturing.

Your participation in this research survey is completely voluntary, you may stop at any time. Your answers will remain anonymous. You will complete one survey that will take you about 10 to 15 minutes to fill out. There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

You may contact the researcher at the following address and phone number, should you desire to discuss your participation in the study: Kaitlyn Sanson, [ksanson@okstate.edu](mailto:ksanson@okstate.edu) 386-237-4889. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or [irb@okstate.edu](mailto:irb@okstate.edu)

Please indicate that you are 18 and above in age, that you are aware your answers will remain anonymous, and that your participation in the survey is completely voluntary.

- Yes
- No

If you are not 18 years of age or older, please return the blank survey to Ms. Sanson.

## Hydraulic Fracturing Survey

In which zip code is your permanent residence?

\_\_\_\_\_

In which zip code is your university residence? 74074 or \_\_\_\_\_

Do you have hydraulic fracturing wells on your permanent residence/property?

- Yes
- No

Do your parents/guardians/siblings have jobs in the oil or natural gas industry?

- Yes
- No

Does anyone in your immediate family receive revenue from oil and gas leases?

- Yes
- No

Do you expect to have a job in the oil and gas industry when you graduate?

- Yes
- No

**Rank the following: 1 being the lowest, 10 being the highest**

The importance of oil and natural gas revenue for sustaining tax revenue in Oklahoma

1    2    3    4    5    6    7    8    9    10

The importance of oil and natural gas jobs in Oklahoma

1    2    3    4    5    6    7    8    9    10

**Rank the following: 1 being not at all concerned, 5 neutral, 10 being very concerned**

Your concern about earthquakes for your safety

1 2 3 4 5 6 7 8 9 10

Your concern about earthquakes for property damage

1 2 3 4 5 6 7 8 9 10

In your opinion, are the earthquakes in the 2011-2015 period in Oklahoma manmade?

Yes, NO, Not sure (circle one)

How knowledgeable on a scale of 1 to 10, 10 being very familiar, 1 being not at all knowledgeable about the processes of hydraulic fracturing to recover natural gas?

Not familiar 1 2 3 4 5 6 7 8 9 10 very familiar

If Oklahoma were to pass a law regarding liability for damage caused by earthquakes due to Hydraulic Fracturing, for what percentage should oil and natural gas companies be liable for earthquakes caused within 20 miles of their injection site?

Please give a number between 0% and 100% \_\_\_\_\_

If you said zero, please explain why:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What percentage should homeowners pay for damages to their own property for earthquakes caused within 20 miles of an injection site?

Please give a number between 0% and 100% \_\_\_\_\_

If you said zero, please explain why:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Do you believe that Oklahoma's legislature should legislate to ensure that home insurance companies cover human induced earthquake damage? Yes or NO

Do you watch Fox News? Yes or No

Do you watch CNN? Yes or No

Do you watch ABC News? Yes or No  
Do you listen to NPR News? Yes or No  
Do you read the USA Today? Yes or No  
Do you read the Washington Post? Yes or No  
Do you read the Wall Street Journal? Yes or No  
Do you read/watch another news source not listed above? Please list:

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Please remember, all of your data will remain anonymous:

Major: \_\_\_\_\_

Gender: Male or Female

Age: \_\_\_\_\_

Additional Comments:

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\_\_\_\_\_ Thank you for your participation.

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My hypothesis of the students' perceptions is that students with family members in the oil and natural gas industry, students' with families that receive revenue from oil and gas leases and students that expect a job within the oil and natural gas industry will put a higher liability percentage on the homeowner and a lower liability on the oil and natural gas companies.

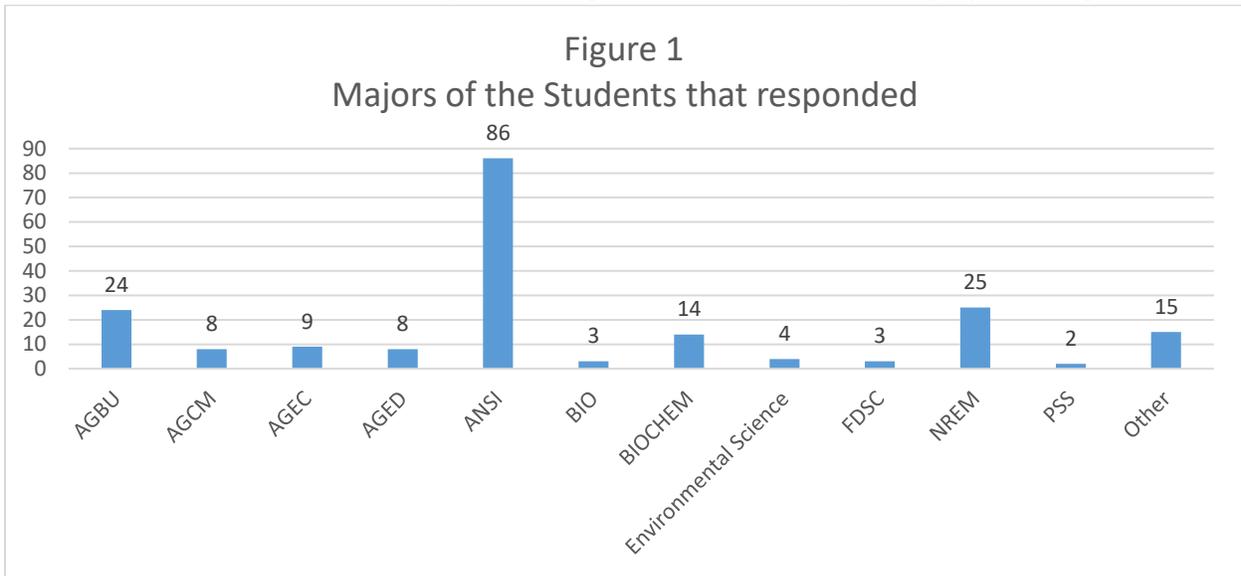
### **Data**

I received 202 responses to my survey. I put all the data into excel and ran regression for both the liability for homeowners and the liability for oil and natural gas companies.

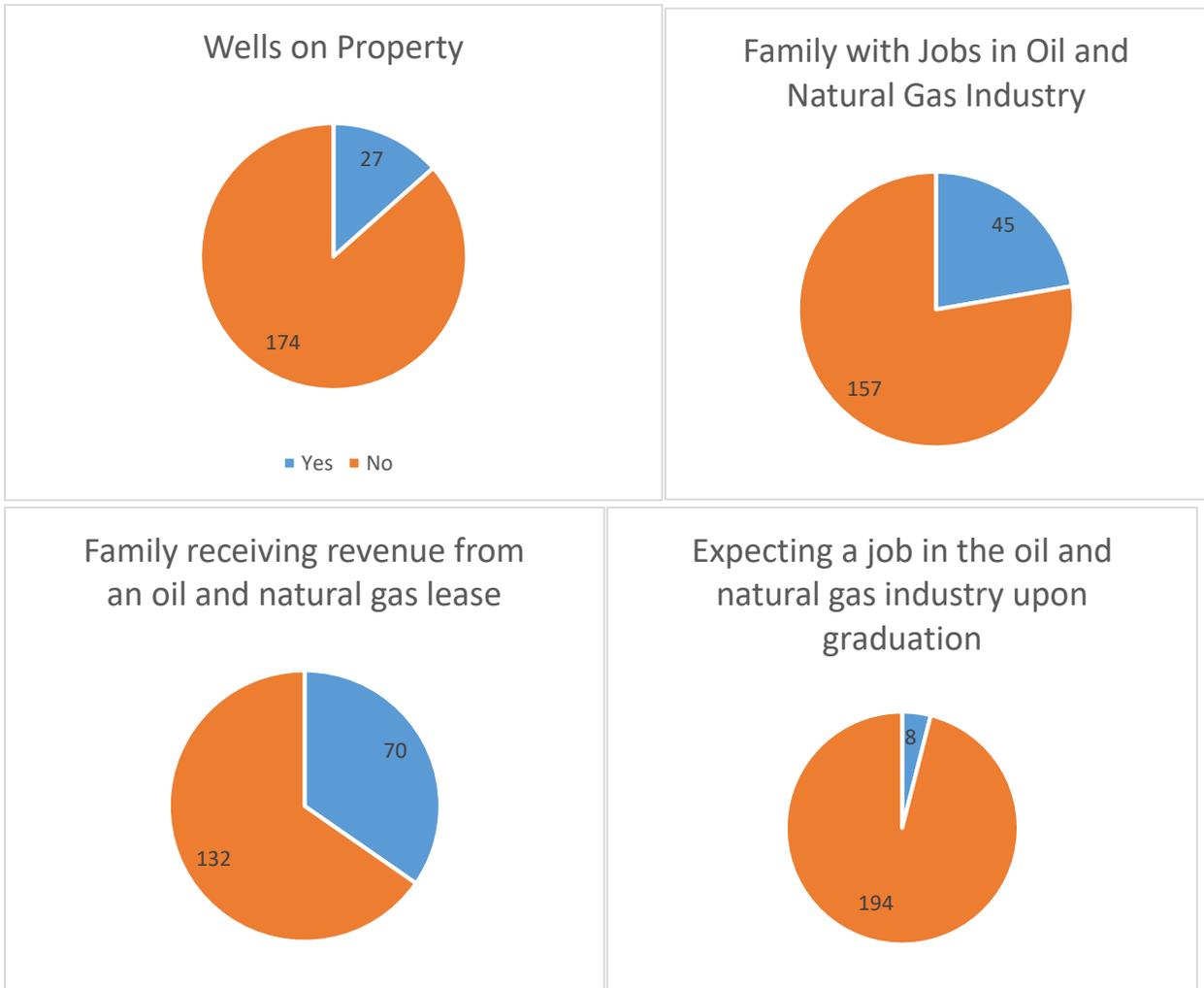
### **Results**

Of the students that responded regarding gender there were 123 females and 73 males. A large majority were from ages 18 to 25. The following are the graphic results of the data collected:

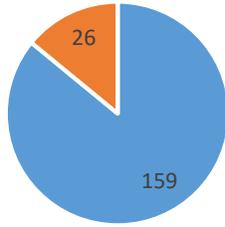
The number of students in each major that responded to the survey is displayed in Figure 1



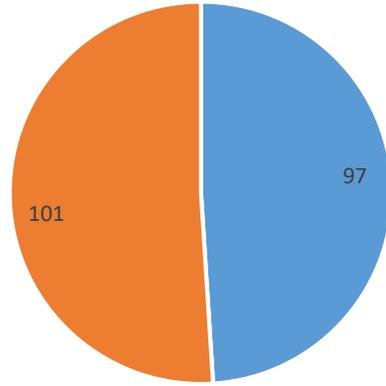
Below are the responses to the “Yes and No” questions. Yes is blue and No is orange:



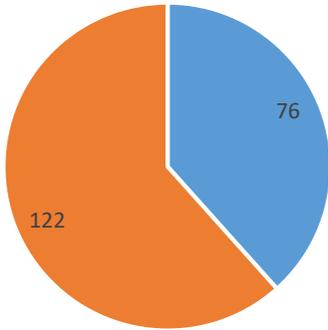
Do you believe that Oklahoma's legislature should legislate to ensure that home insurance companies cover human induced earthquake damage?



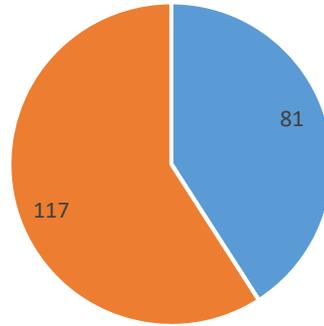
Fox News



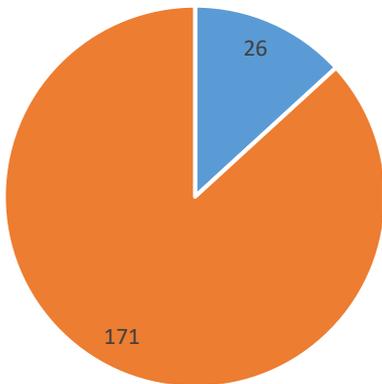
CNN



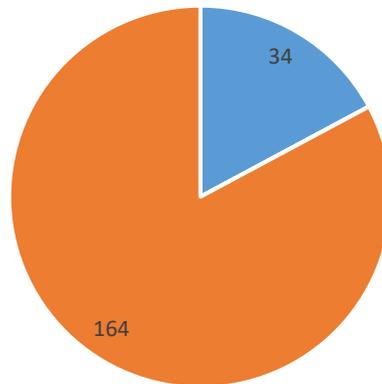
ABC News

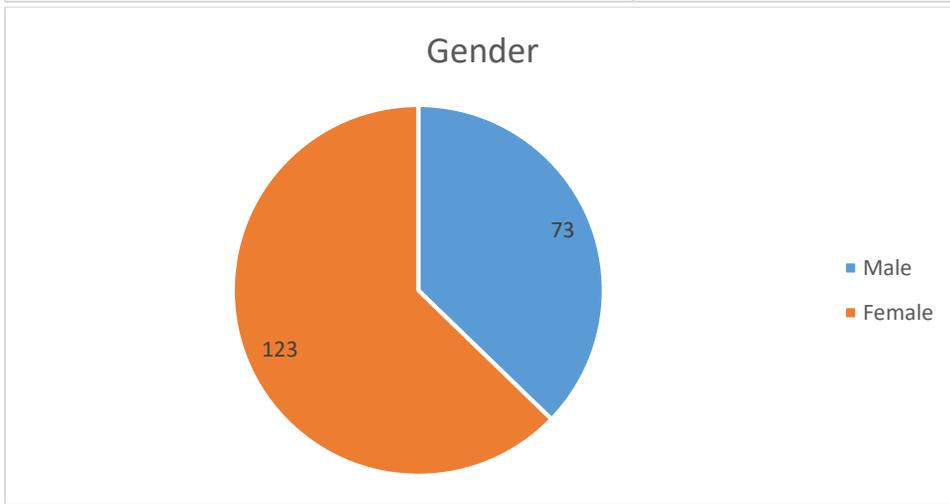
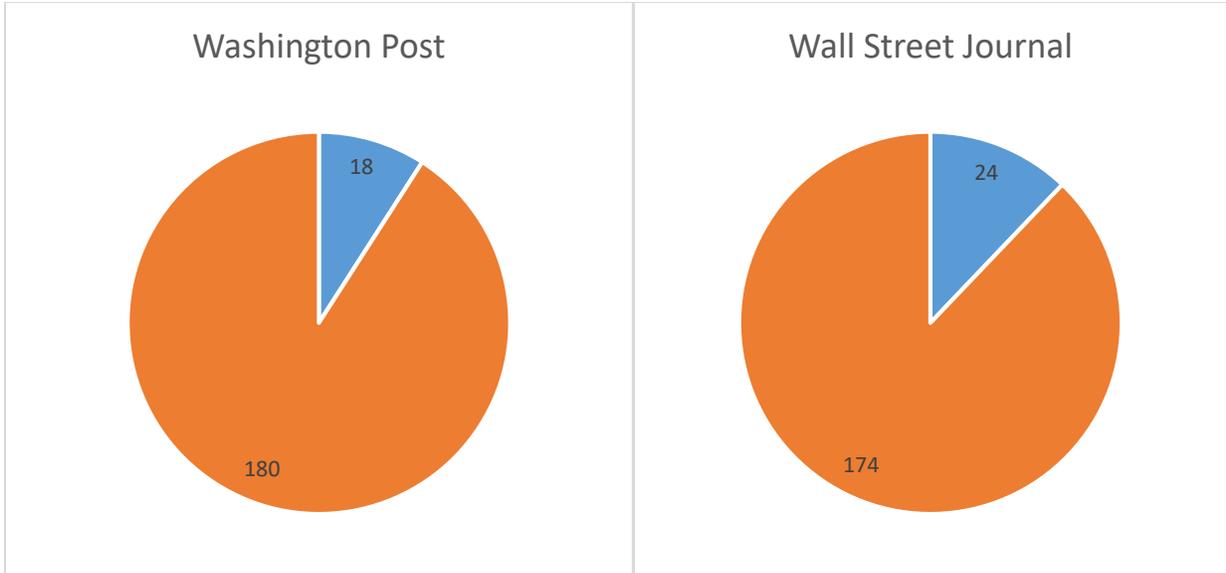


NPR News

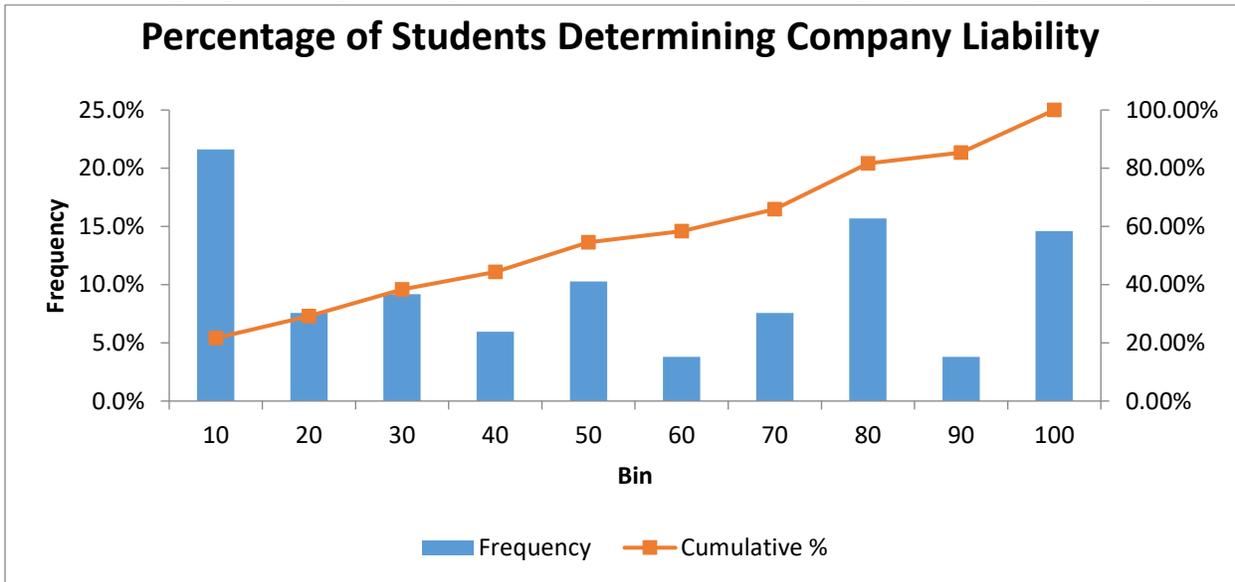


USA Today





The following depicts the percentage of students that ranked a company liability percentage:



The following is the regression for Company Liability:

SUMMARY OUTPUT for company liability

<i>Regression Statistics</i>					
Multiple R			0.570471		
R Square			0.325438		
Adjusted R Square			0.290746		
Standard Error			28.56568		
Observations			185		

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	9	68892.66	7654.74	9.380829	1.38E-11
Residual	175	142799.7	815.9982		
Total	184	211692.3			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>
Intercept	42.09719	13.12858	3.20653	0.001597	16.18646
Wells on Property	-10.3536	6.593588	-1.57025	0.118164	-23.3667
Family have job in the industry	-11.0908	5.256103	-2.11008	0.036273	-21.4643
Family receive revenue from oil and gas leases	0.954757	5.071583	0.188256	0.850894	-9.05458
Expect to have a job in the industry upon graduation	-1.42132	11.48697	-0.12373	0.901669	-24.0922
Importance of oil and gas revenue for sustaining tax revenue in OK	-0.36423	1.804337	-0.20186	0.840258	-3.92529
Importance of oil and gas jobs in Ok	-0.8378	1.727517	-0.48497	0.628303	-4.24725
Concern about earthquakes for your safety	4.414463	1.32463	3.332601	0.00105	1.800157
Concern about earthquakes for property damage	1.03211	1.427435	0.723052	0.470613	-1.78509
Knowledge	-1.36699	0.819031	-1.66903	0.096899	-2.98344

**Conclusion**

As the results show, the highest percentage for company liability was less than ten percent. I found it interesting that only 37 percent of the respondents were male as Oklahoma State University is pretty evenly divided gender wise. The majority of the respondents were animal science majors, this could be because this is the biggest department in the College of Agricultural Sciences and Natural Resources. There is a very strong negative correlation between company liability and students that have families that work within the industry. This is what I predicted in my hypothesis since students typically defend their families, or in this case, the industry that their family is involved in. As the percent of company liability increased so did the concern for the students' personal safety. This could be because they feel that if they get hurt they would want the oil and natural gas company to help them pay for whatever injuries the

damage could have caused. I conclude that students' perceptions of earthquake liability are based more on individual or family influence rather than a research developed opinions.

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