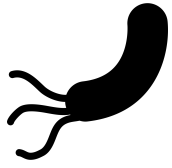


IS ANITMICROBIAL RESISTANCE INCREASING?

DATA SCIENCE PREP COURSE CAPSTONE PROJECT

Rich Gorham

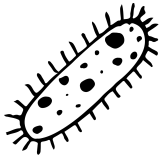
https://github.com/richardgorham1/ds-prep-capstone.git

THE ISSUE

Arms race. Antimicrobial resistance is increasing worldwide.

Discovery void. Antimicrobial has substanically decreased since the mid 1990's.

World Health Organization. Antimicrobial resistance: global report on surveillance. World Health Organization 2014

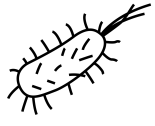


THE ISSUE

Mortality rates:

Circa 1920(EU and US): 30 per 10,000
Circa 1990(EU and US): 0.005 per 10,000
by 2050(WW): 20 fold increase

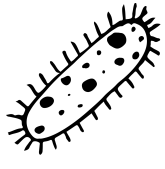
Runcie H (2015) Infection in a Pre-Antibiotic Era. J Anc Dis Prev Rem 3: 125. doi:10.4172/2329-8731.1000125



MONITORING EFFORTS

Worldwide, regional, and national monitoring.

National Antimicrobial Resistance Monitoring System (NARMS)

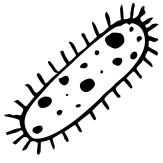


OBJECTIVES

- Look for general trends and patterns
- Interpret findings
- Develop proposal for future study / analysis

METHODS

- Manage data - Pandas
- Caluclations, statistical and otherwise - Numpy, SciPy
- Charts and visualization - Matplotlib

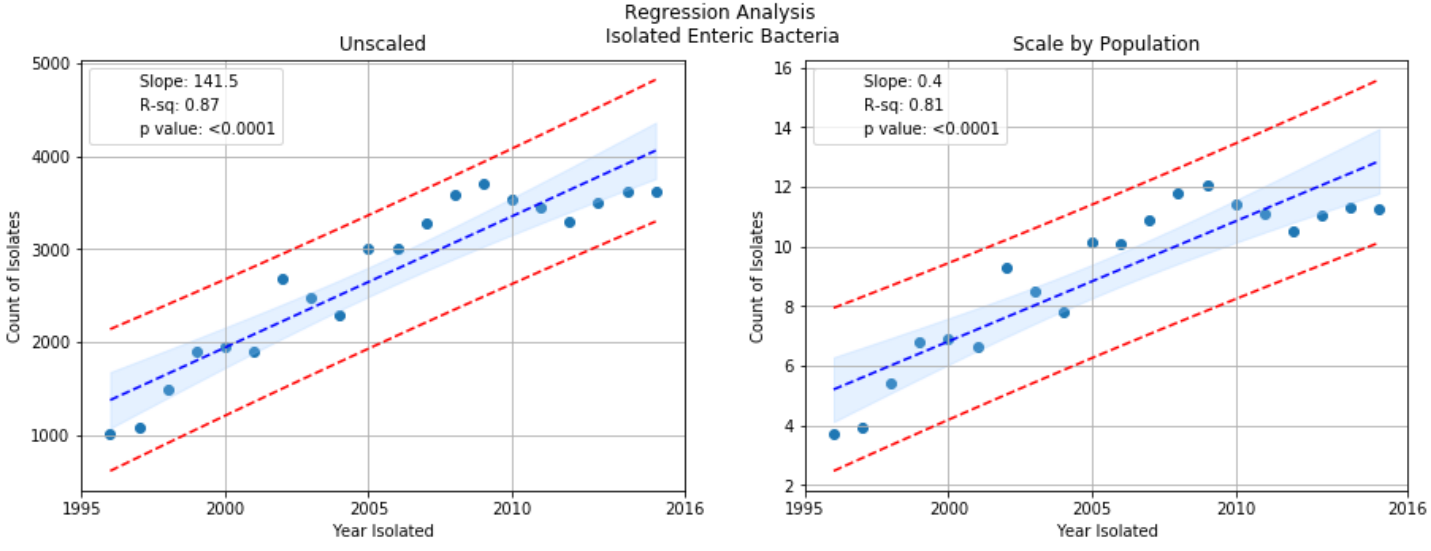


ENTERIC BACTERIA DATABASE

The CDC's NARMS Enteric Bacteria Database:

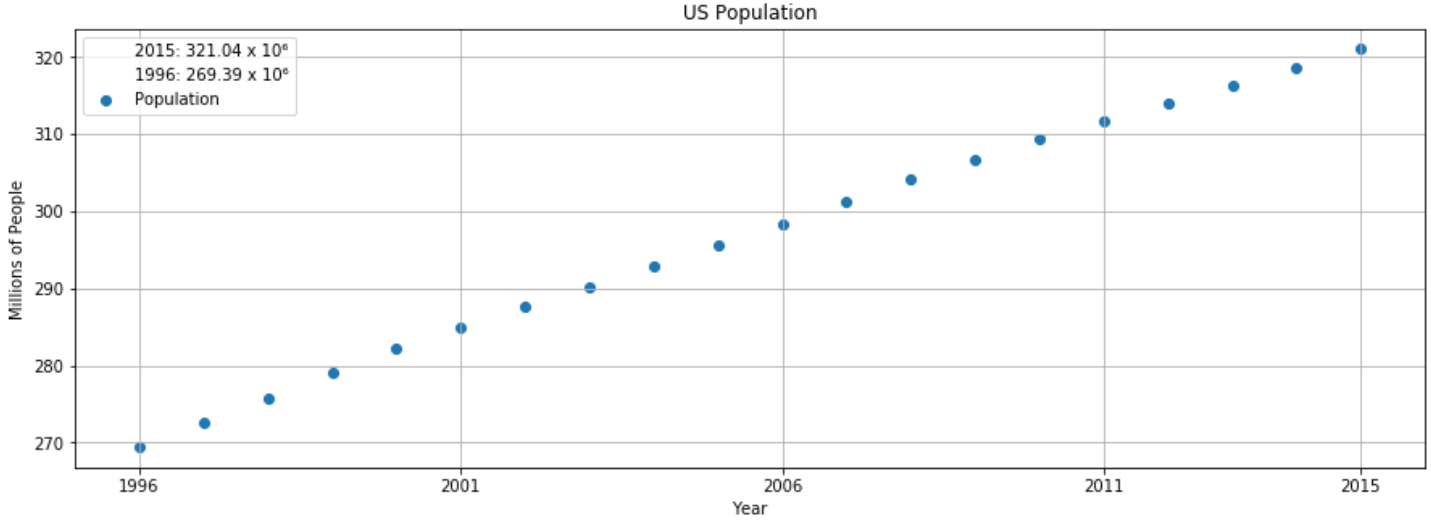
- Covers specimens collected from 1996 to 2015
- Tests against 31 antimicrobials
- Some resistome information

https://wwwn.cdc.gov/narmsnow/

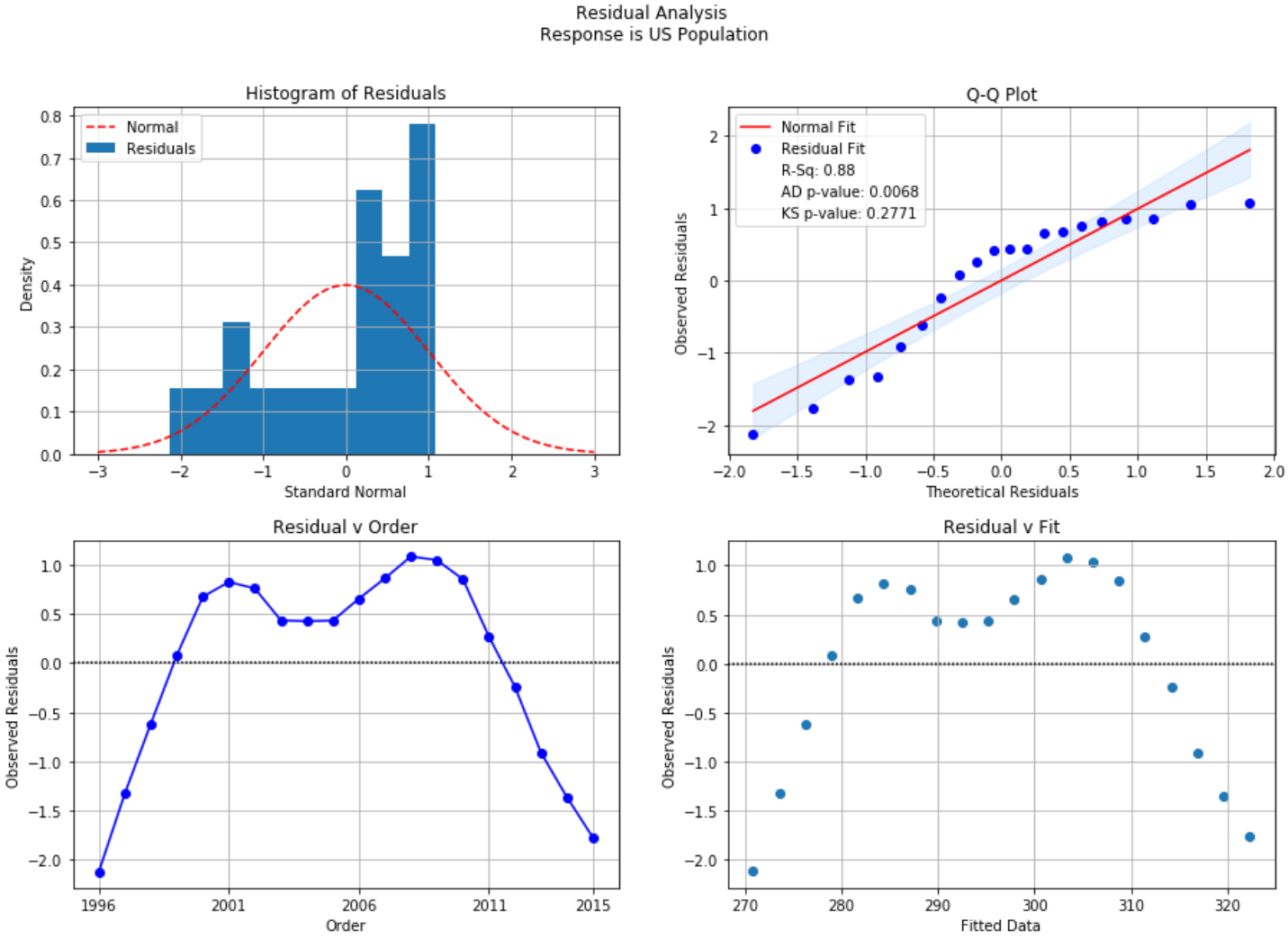


Set	Slope	Intercept	R^2	p for Regression
unscaled	141.5	-281056.13	0.87	<0.0001
scaled	0.4	-799.04	0.81	<0.0001

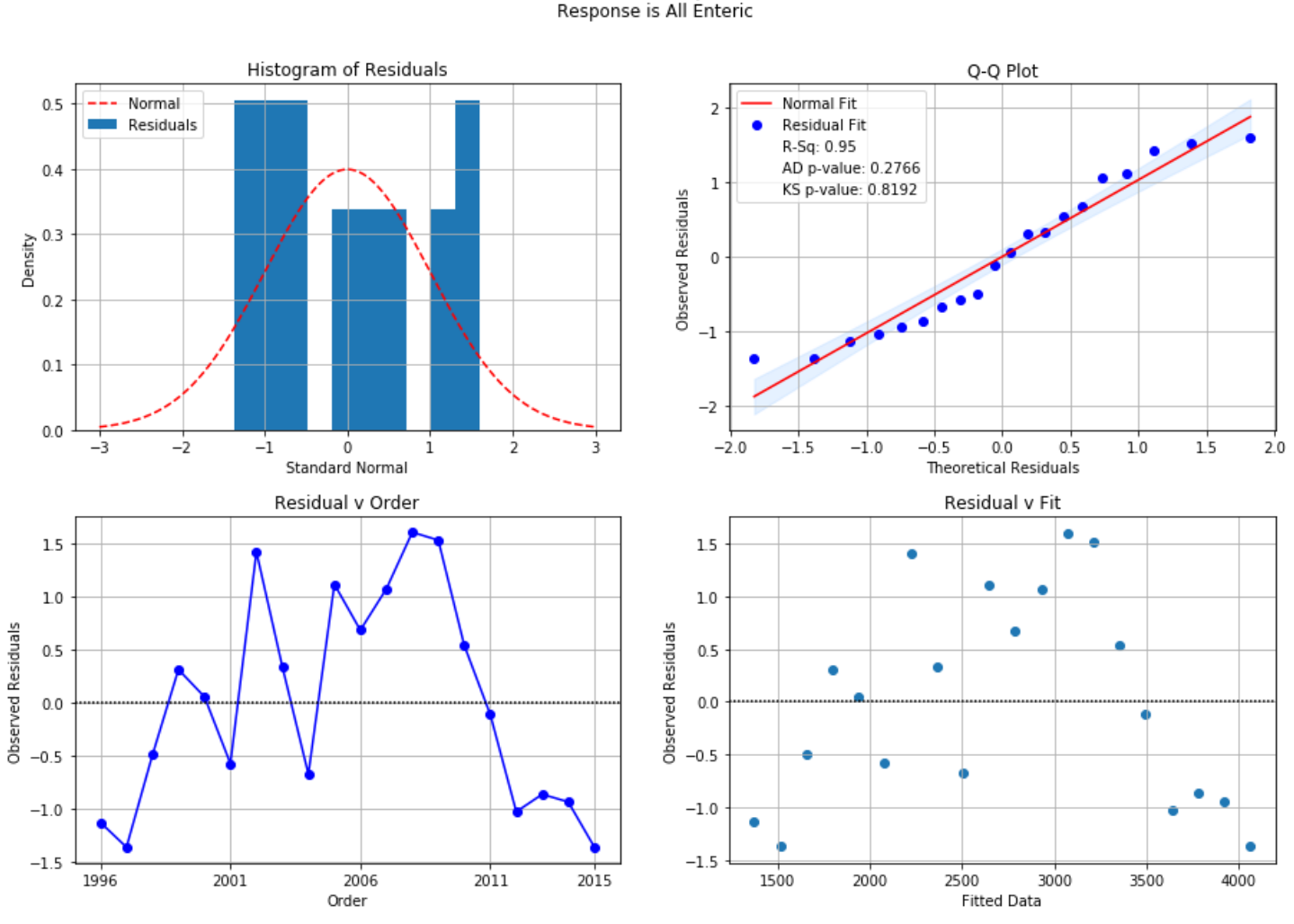
Scatter plots of enteric bacteria with regression, and prediction and confidence limits, unscaled and scaled to US population for the same period.



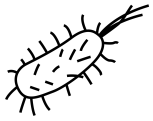
Scatter plot of US population, 1996 to 2015. The scatter looks linear, analysis below shows otherwise.

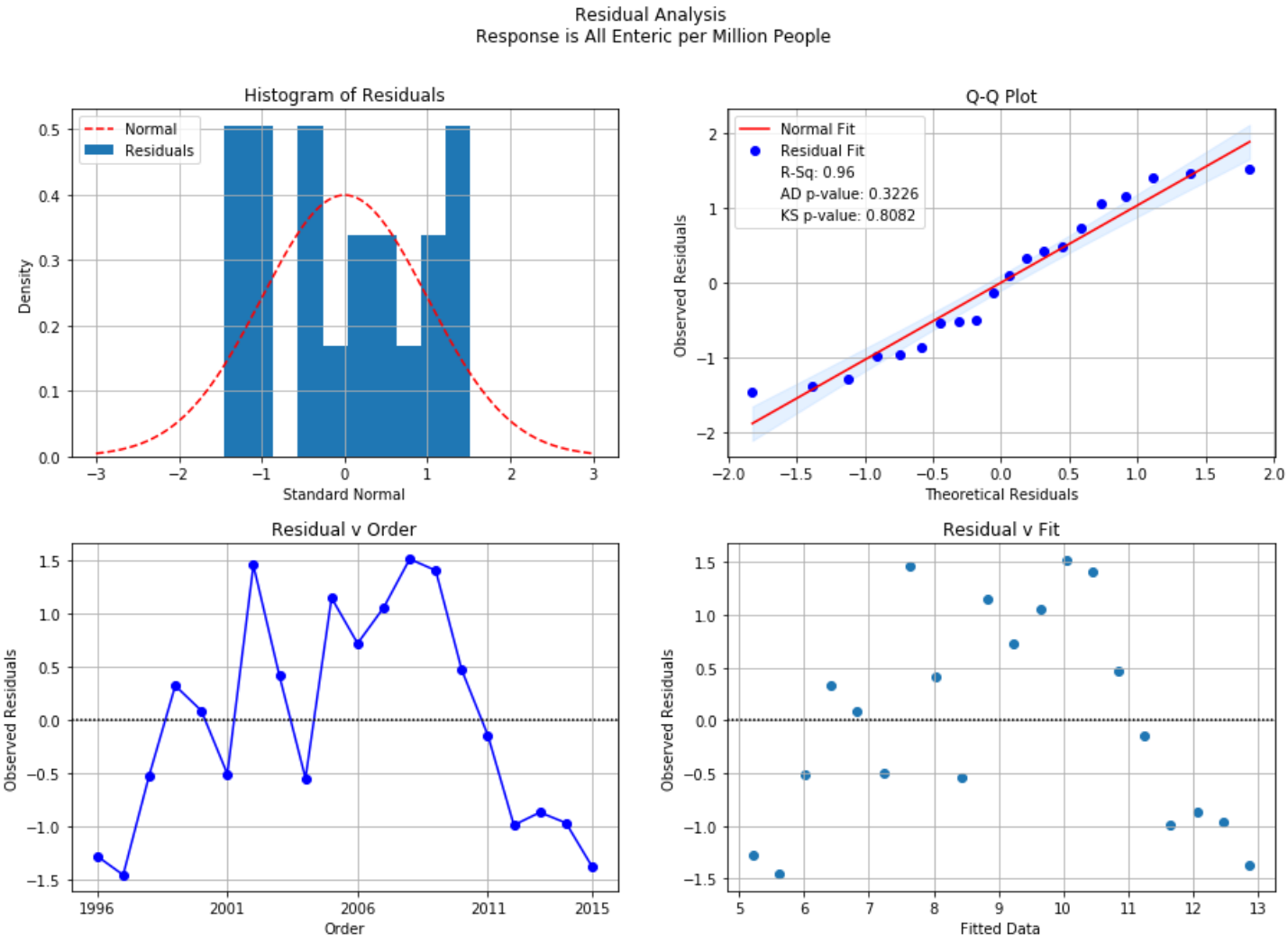


Residual analysis for linear regression of US population.
The residuals do not prove to be normal and are not well dispersed.

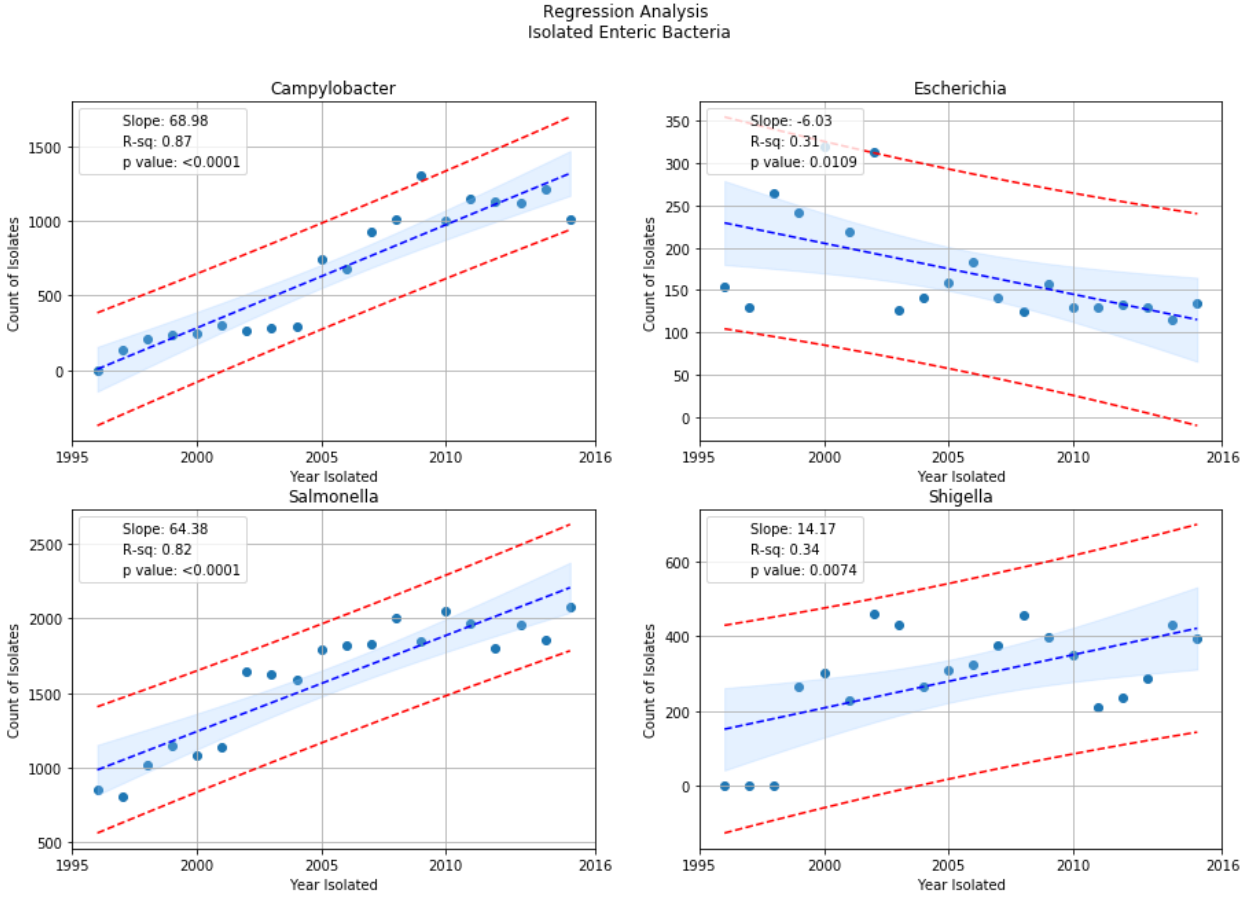


Residual analysis for linear regression of all incidences of enteric bacteria.
The residuals prove to be normal and well dispersed.



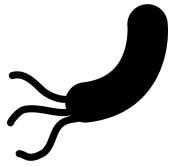


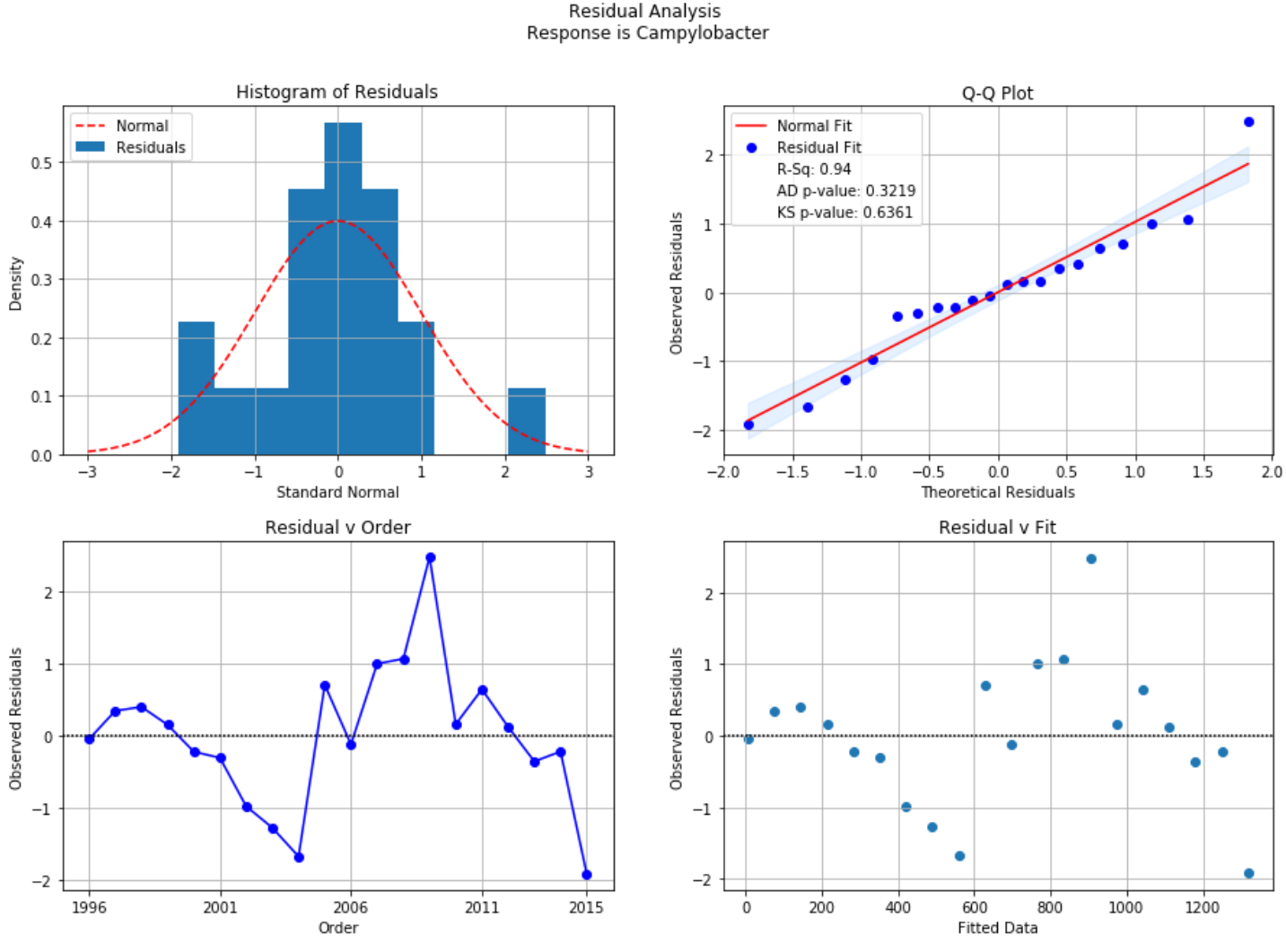
Residual analysis for linear regression of all incidences of enteric bacteria, scaled to US population. The residuals prove to be normal and well dispersed.



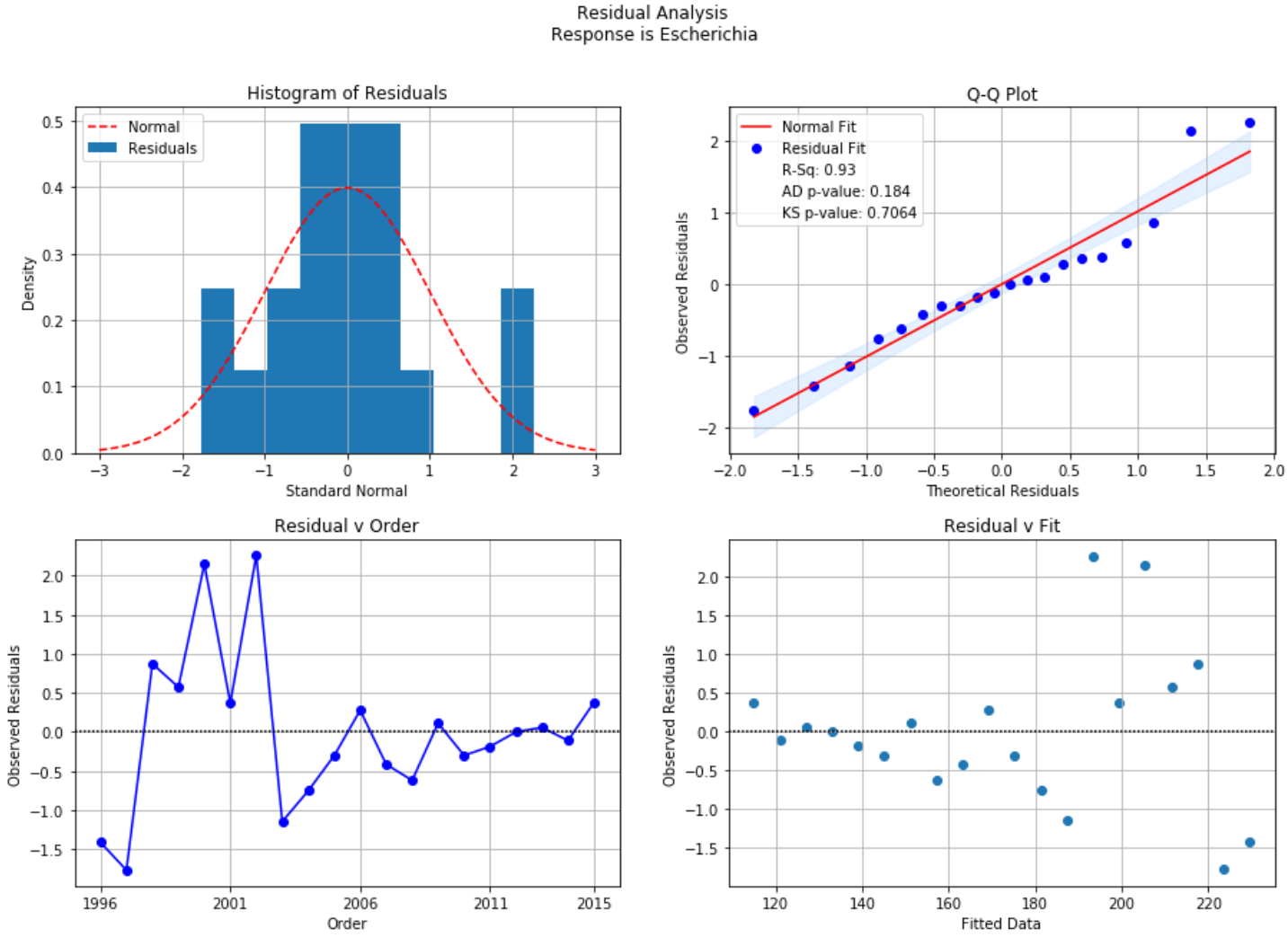
Set	Slope	Intercept	R^2	p for Regression
Campylobacter	68.98	-137682.27	0.87	<0.0001
Escherichia	-6.03	12267.0	0.31	0.0109
Salmonella	64.38	-127514.02	0.82	<0.0001
Shigella	14.17	-28126.91	0.34	0.0074

Scatter plots for the four genera in the data set.

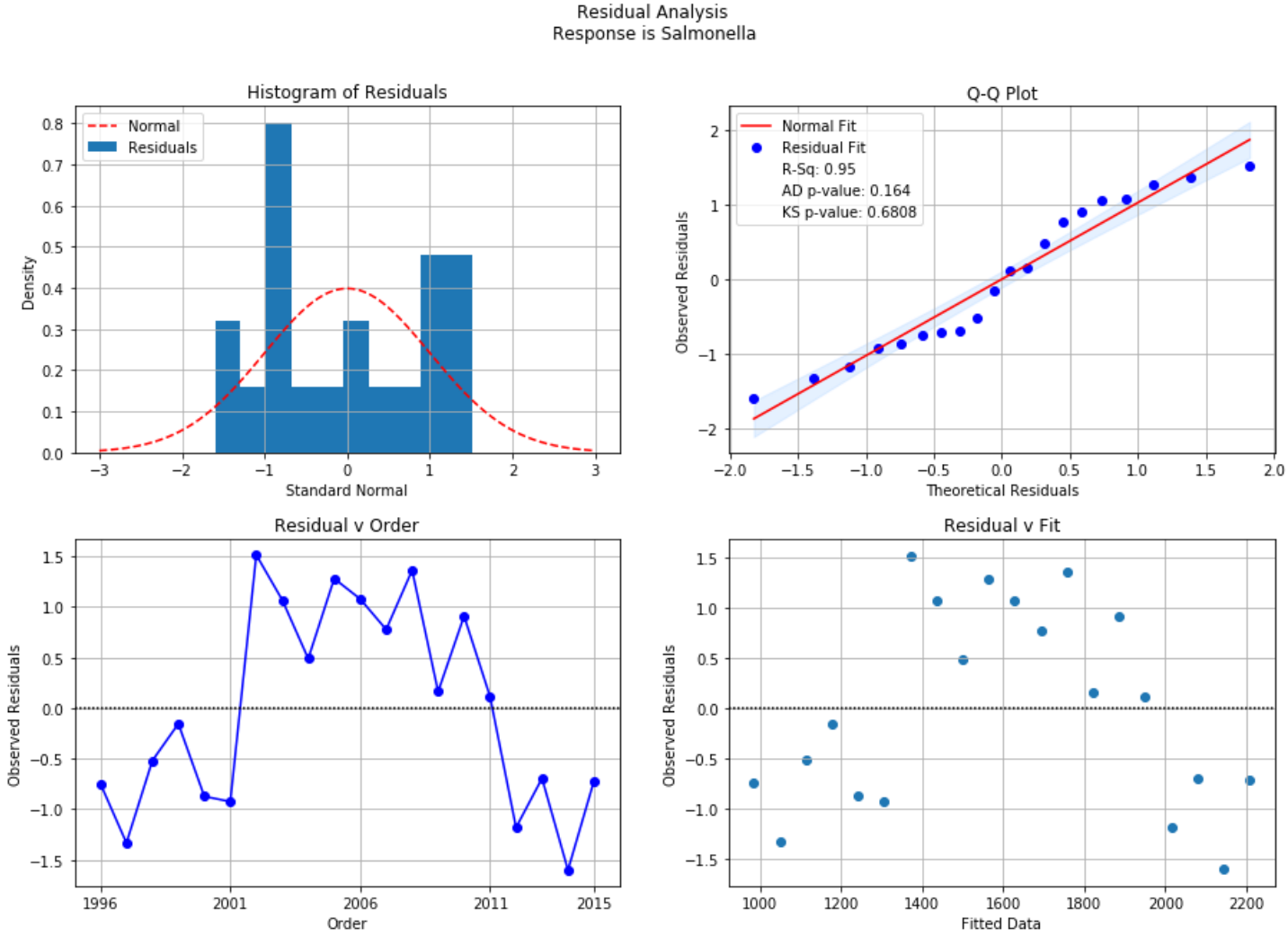




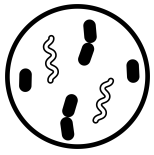
Residual analysis for Campylobacter. *The residuals form a normal distribution and are well dispersed.*

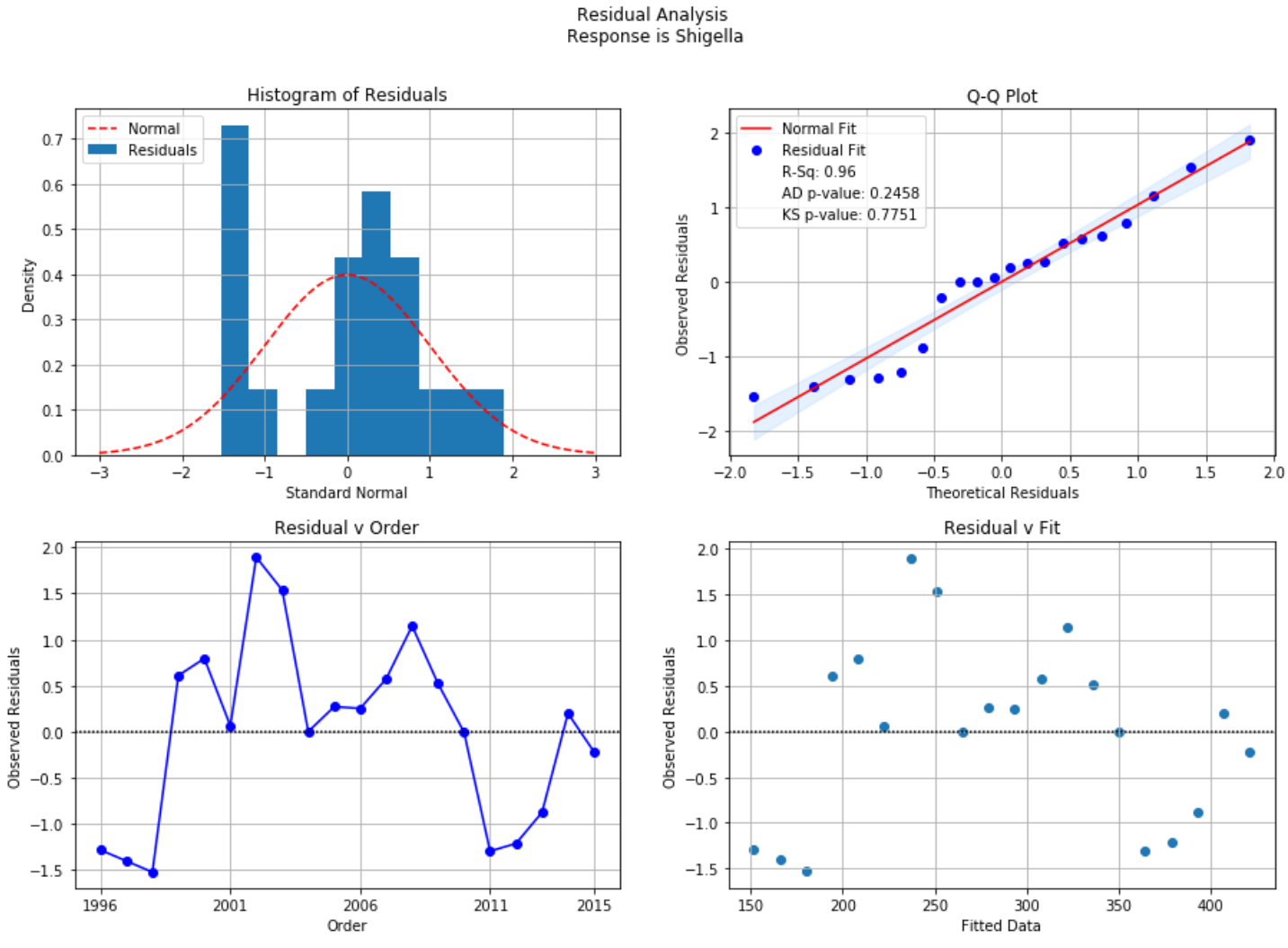


Residual analysis for Escherichia. *The residuals form a normal distribution and are well dispersed.*

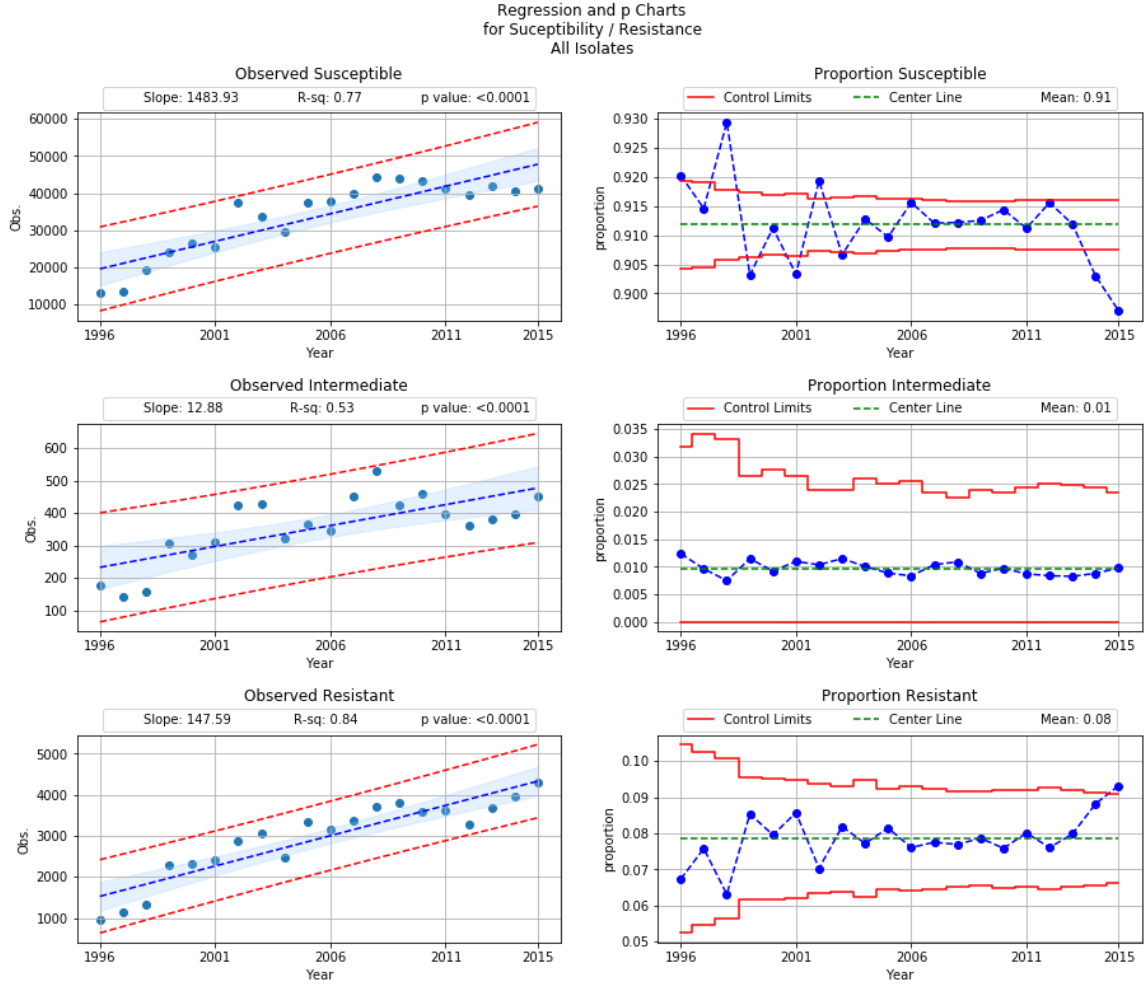


Residual analysis for Salmonella. *The residuals form a normal distribution and are well dispersed.*

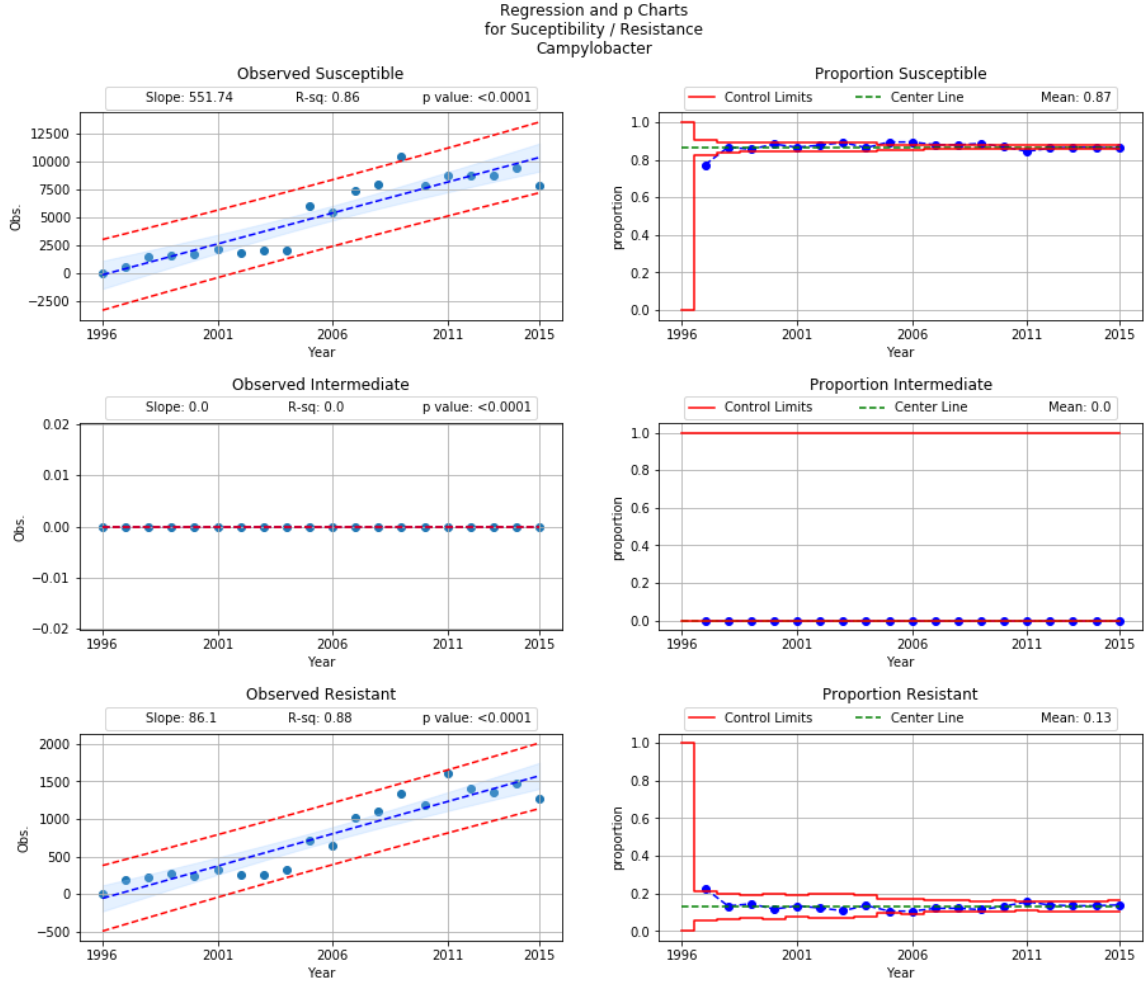




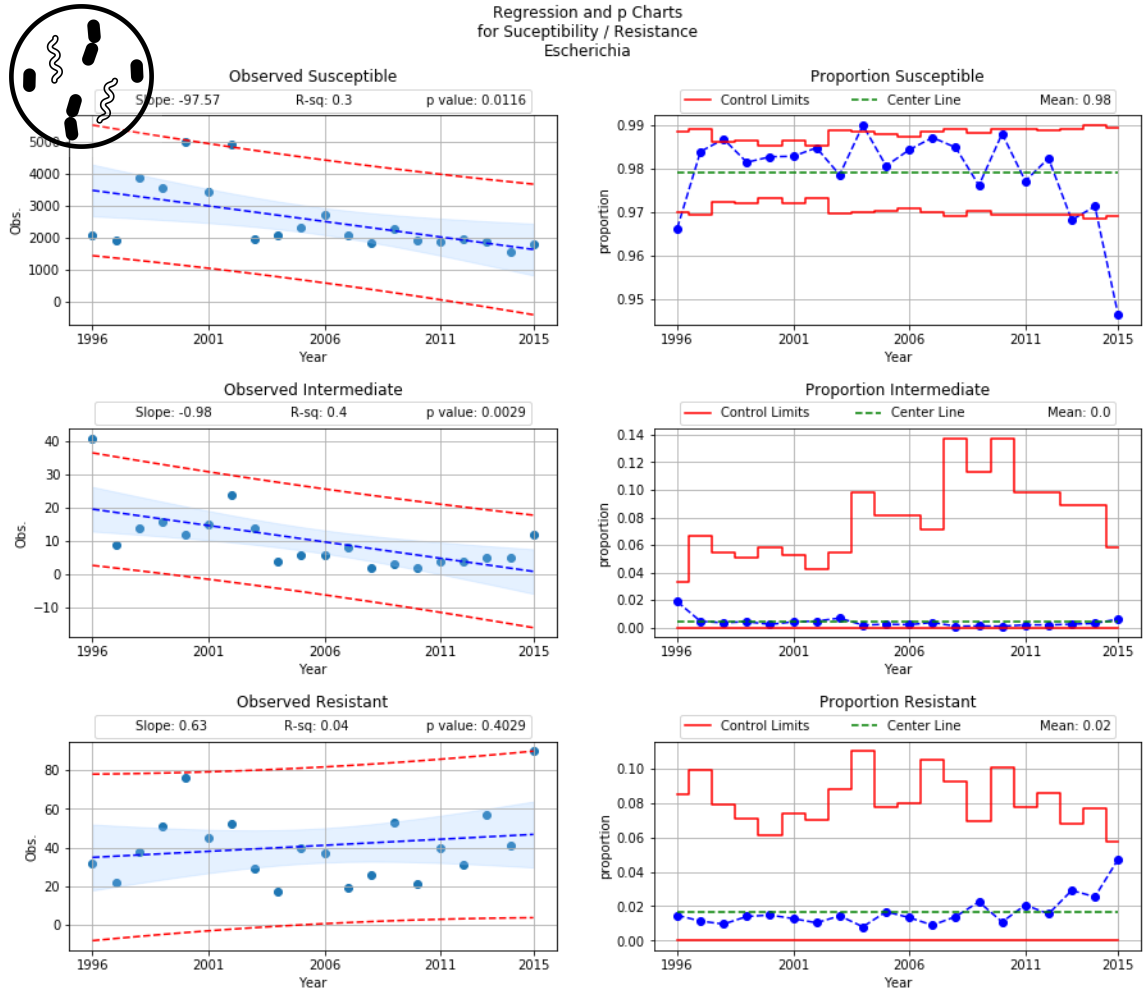
Residual analysis for Shigella. *The residuals form a normal distribution and are well dispersed.*



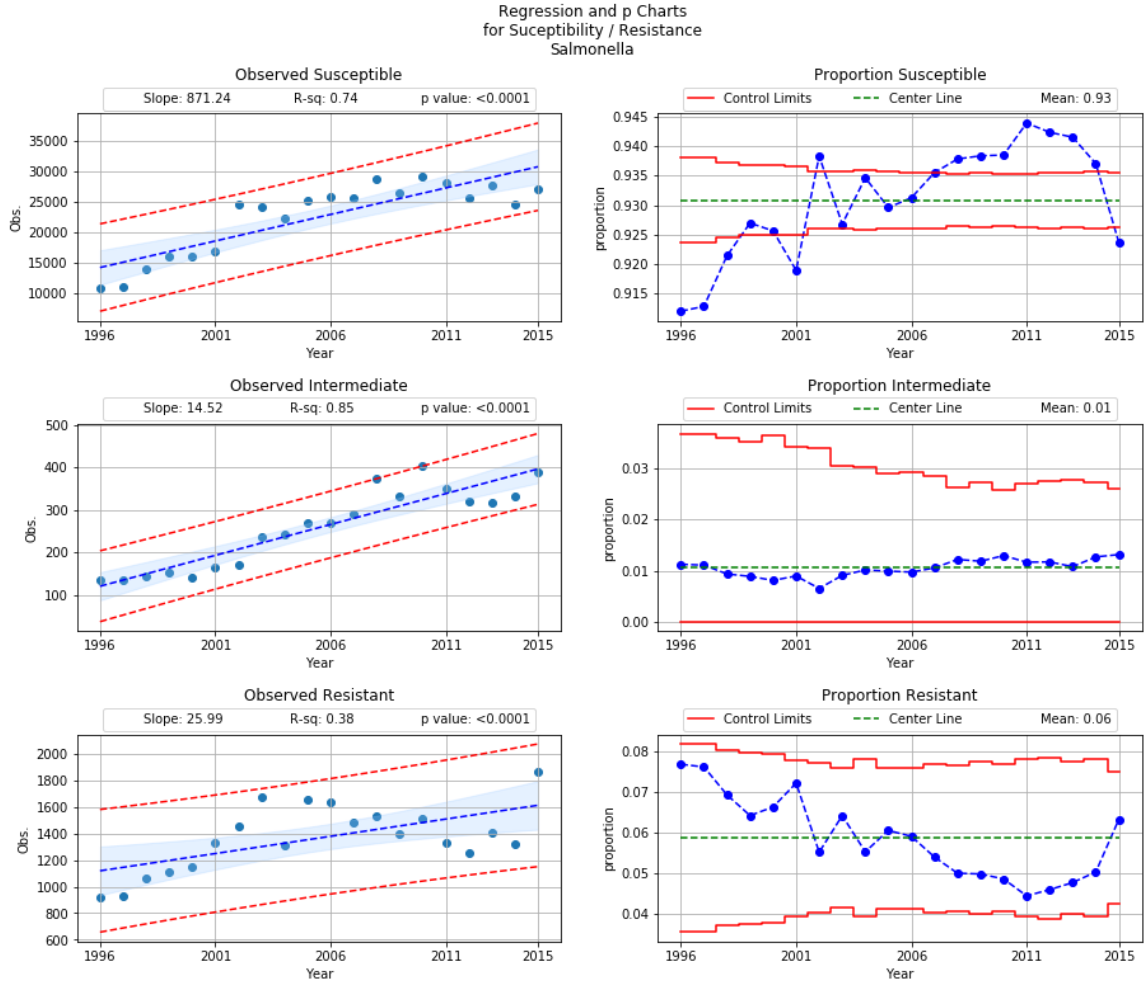
Scatter and proportion plots for all eneric bacteria. Note that the last few years show a decrease in susceptible isolates and corresponding increase in resistant isolates.



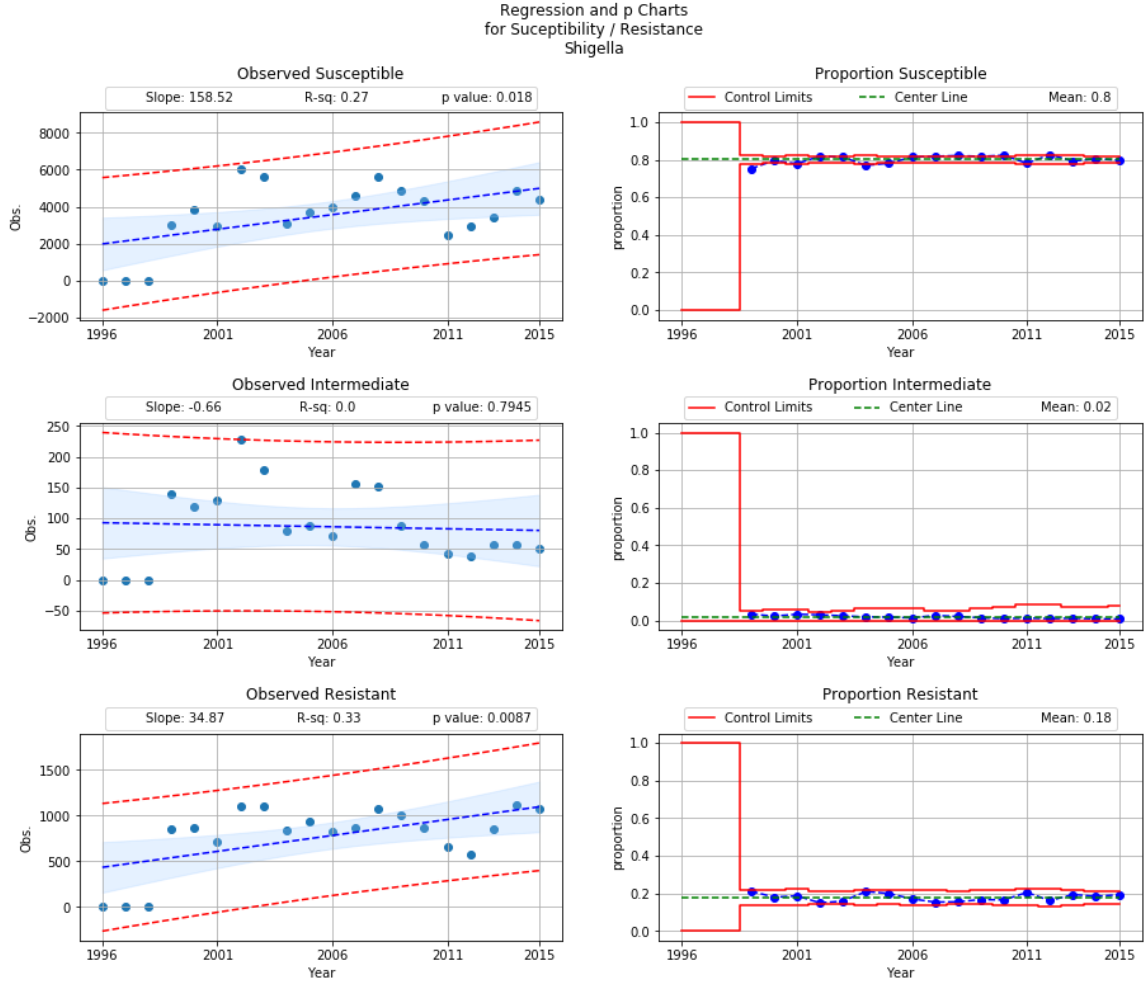
Scatter and proportion plots for Campylobacter. *Note a rather stable proportion in resistance.*



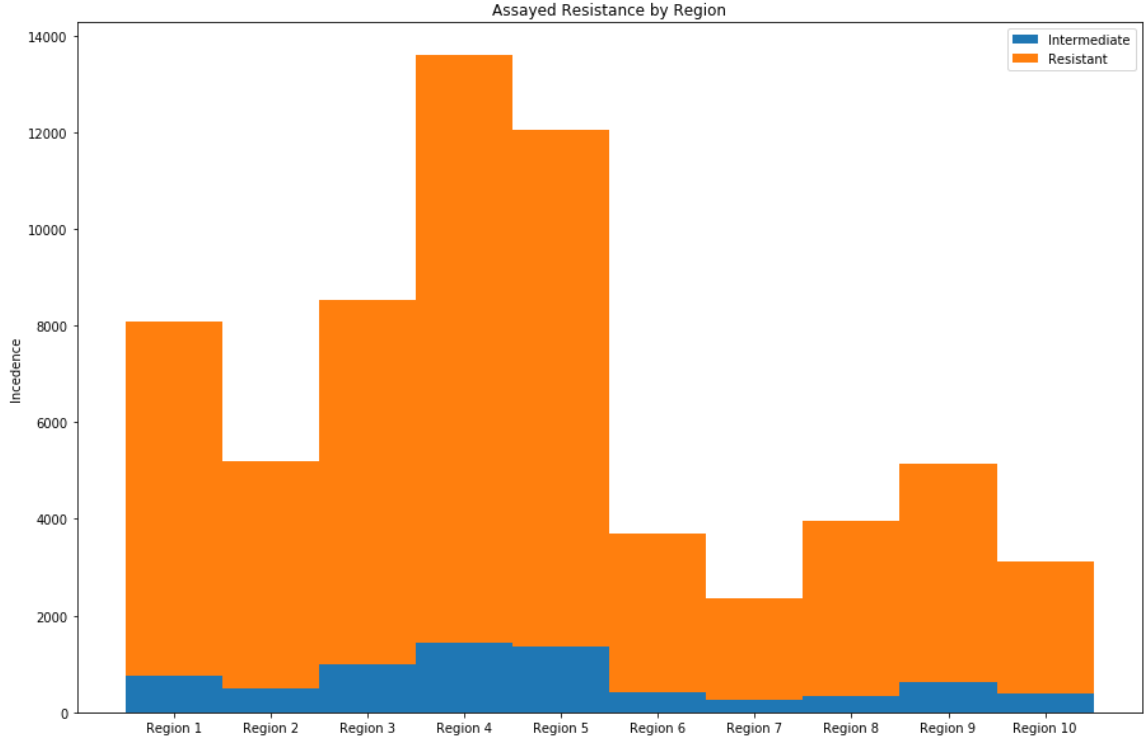
Scatter and proportion plots for Escherichia. *There is some detectable movement between susceptible and resistant bacteria.*



Scatter and proportion plots for Salmonella. *There is some detectable movement between susceptible and resistant bacteria.*

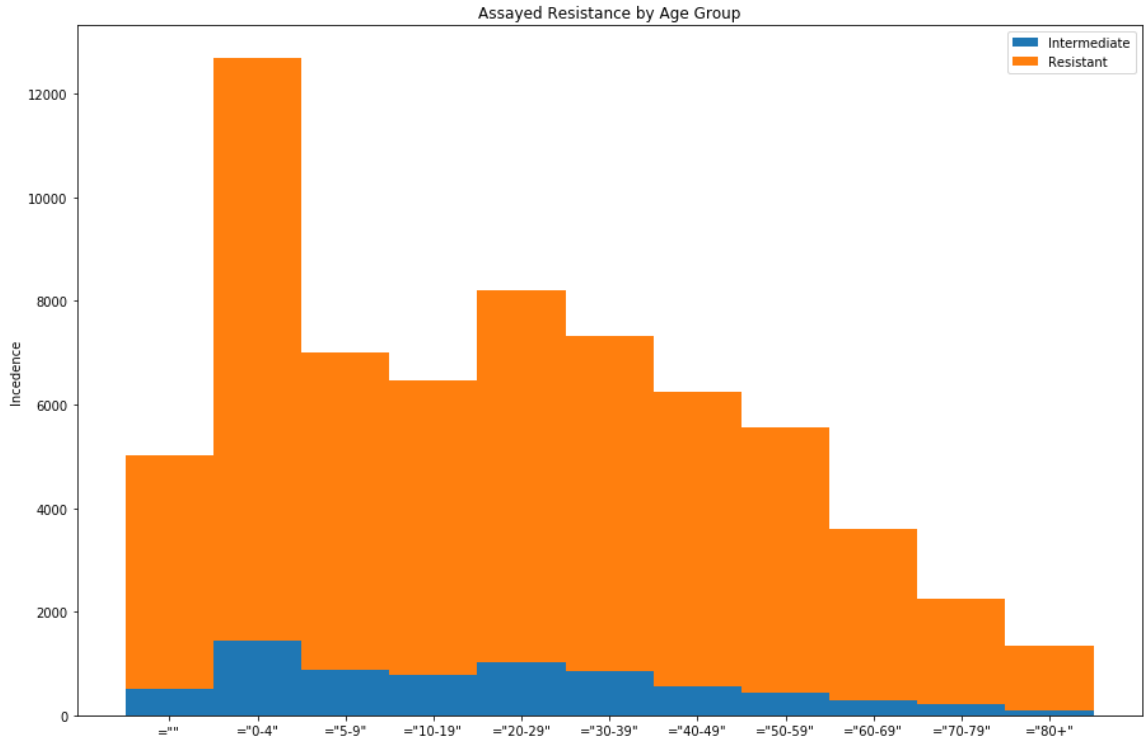


Scatter and proportion plots for Shigella. *The proportions of susceptible and resistant bacteria are stable.*



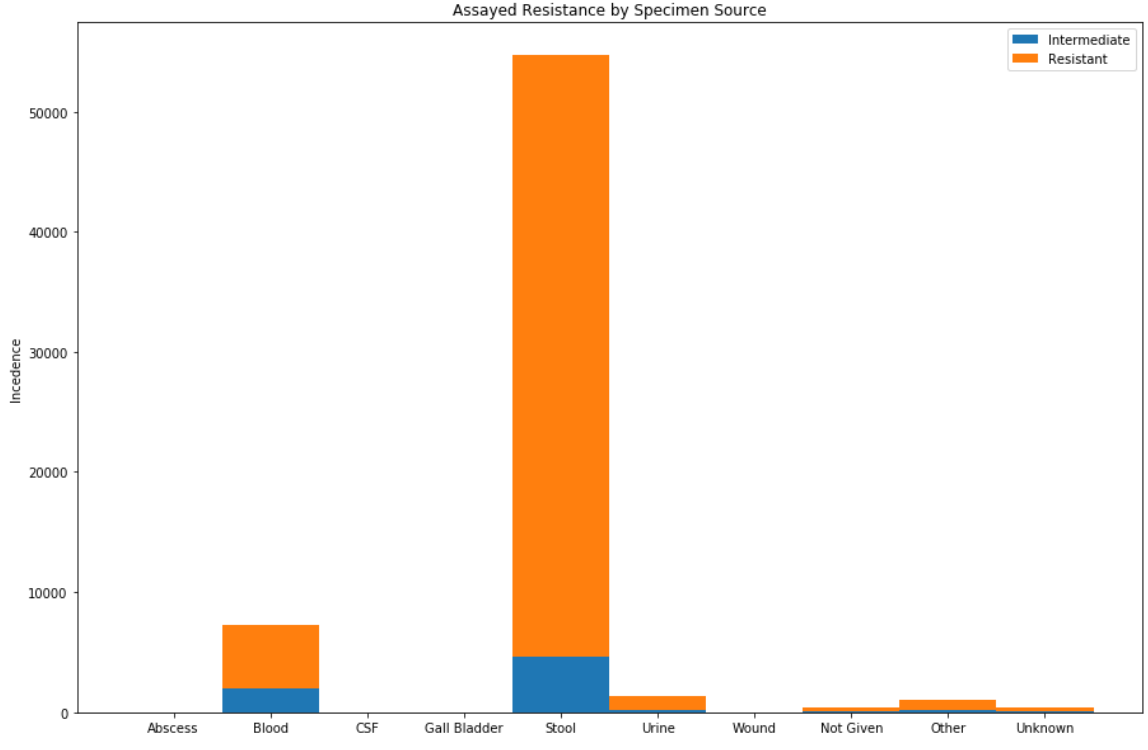
Differnces observed between regions.

Set	Chi-Sq	p value
Intermediate	2,303	<0.0001
Resistant	18,184	<0.0001



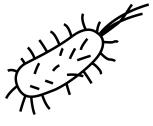
Differences observed between age groups.

Set	Chi-Sq	p value
Intermediate	2,465	<0.0001
Resistant	13,664	<0.0001



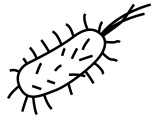
Differences observed from sepcimen source.

Set	Chi-Sq	p value
Intermediate	29,291	<0.0001
Resistant	376,847	<0.0001



CONCLUSIONS

- The observation of enteric bacteria has increased over the years, but this could be due to improvements to monitoring.
- There is some evidence that the proportion of resistance is increasing at least in some enteric bacteria.



PROPOSAL

- There is widespread concern about antimicrobial resistance.
- Good information about the prevalence of antimicrobial resistance is not available.
- Resistomes to most anitmicrobials have been sequenced and identified.

Search a database of genetic sequences of enteric bacteria for the resistomes to develop prevalence information. Include both pathogenic and nonpathogenic baceria.