Predicting Chronic Pain from Pelvic Positioning Data

Henry Schwab Data Science June 20th, 2017



The Problem: Back Pain

#1

Cause of disability worldwide

50%

of working Americans experience it every year.

1.5 Years

Average time from pain onset to seeking treatment.

90%

Don't know the underlying cause of their pain.

The Data Set

310 Rows x 13 Columns

Pelvic Incidence Pelvic Tilt Lumbar Lordosis Sacral Slope Pelvic Radius Spondylosthesis (slippage) Pelvic Slope Direct Tilt Thoracic Slope Cervical Tilt Sacrum Angle Scoliosis Slope Abnormal? (Y/N)

The Data Set

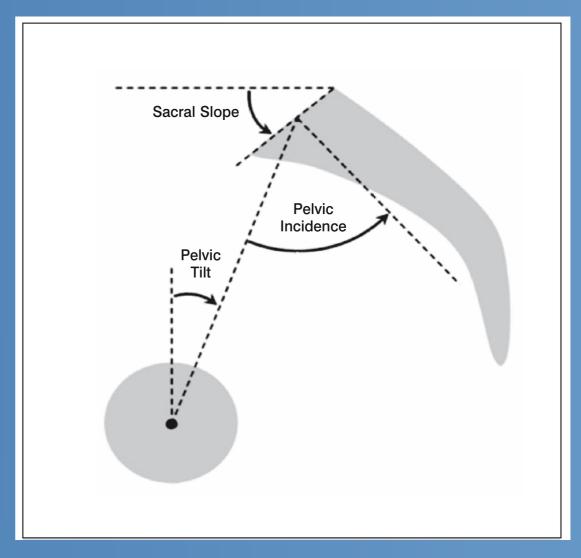
310 Rows x 13 Columns

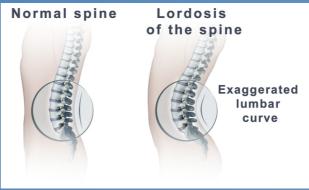
Pelvic Incidence
Pelvic Tilt
Lumbar Lordosis
Sacral Slope

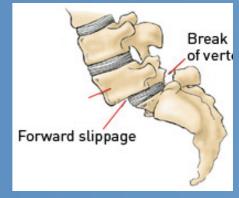
Pelvic Radius

Spondylosthesis (slippage)

Pelvic Slope
Direct Tilt
Thoracic Slope
Cervical Tilt
Sacrum Angle
Scoliosis Slope
Abnormal? (Y/N)







Problem Statement

Using spinal imaging data from ~200 abnormal patients and ~100 normal patients, predict which patients are likely to develop back pain due to abnormal spine.

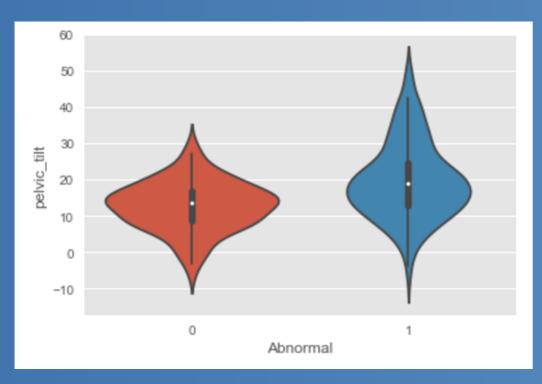
Goal:

Develop a model that can predict who is at risk for developing chronic pain, using measurements that can be easily obtained.

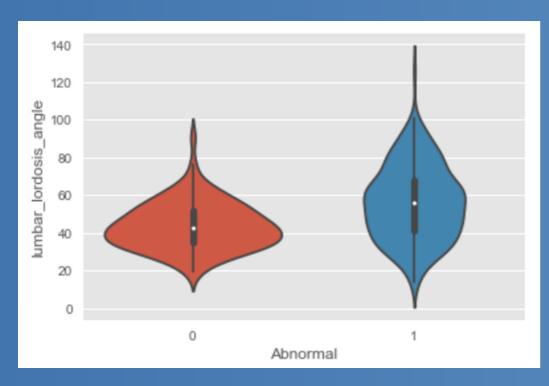
Hypothesis:

Pain can be forecast with 90% accuracy solely based on inputs from the lumbar spine and below.

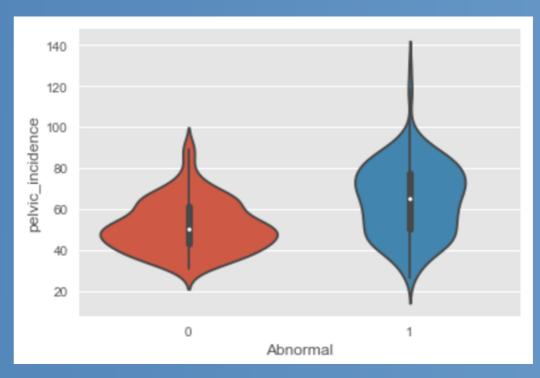
Exploratory Analysis:



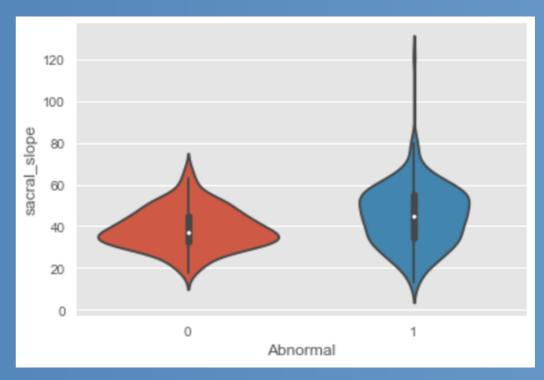
Pelvic Tilt



Lumbar Lordosis

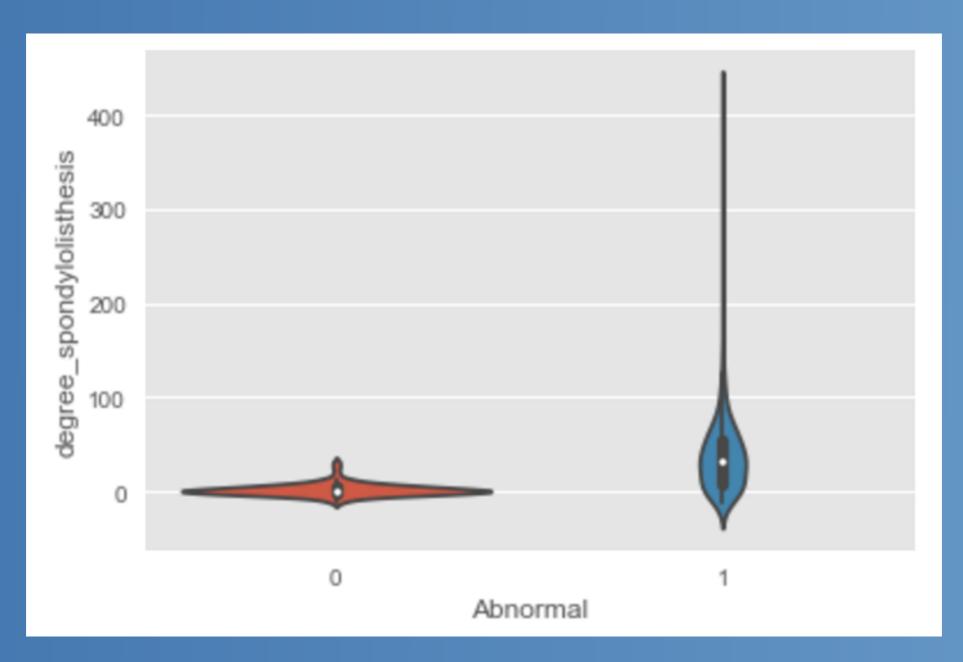


Pelvic Incidence



Sacral Slope

Exploratory Analysis:



Spondylolisthesis

Exploratory Analysis:

Pelvic Incidence	1	0.63	0.72	0.81	0.64	0.043	0.017	0.019	0.35
Pelvic Tilt	0.63	1	0.43	0.062	0.4	0.0089	0.029	0.033	0.33
Lumbar Lordosis Angle	0.72	0.43	1	0.6	0.53	0.029	0.064	0.057	0.31
Sacral Slope	0.81	0.062	0.6	1	0.52	0.049	-6.3e-05	0.00021	0.21
Spondylolisthesis Degree	0.64	0.4	0.53	0.52	1	0.086	0.057	0.023	0.44
Pelvic Slope	0.043	0.0089	0.029	0.049	0.086	1	0.088	0.061	0.056
Cervical Tilt	0.017	0.029	0.064	-6.3e-05	0.057	0.088	1	0.057	0.1
Sacrum Angle	0.019	0.033	0.057	0.00021	0.023	0.061	0.057	1	0.027
Outcome	0.35	0.33	0.31	0.21	0.44	0.056	0.1	0.027	1
	Pelvic Incidence	Pelvic Tilt	nbar Lordosis Angle	Sacral Slope	dylolisthesis Degree	Pelvic Slope	Cervical Tilt	Sacrum Angle	Outcome

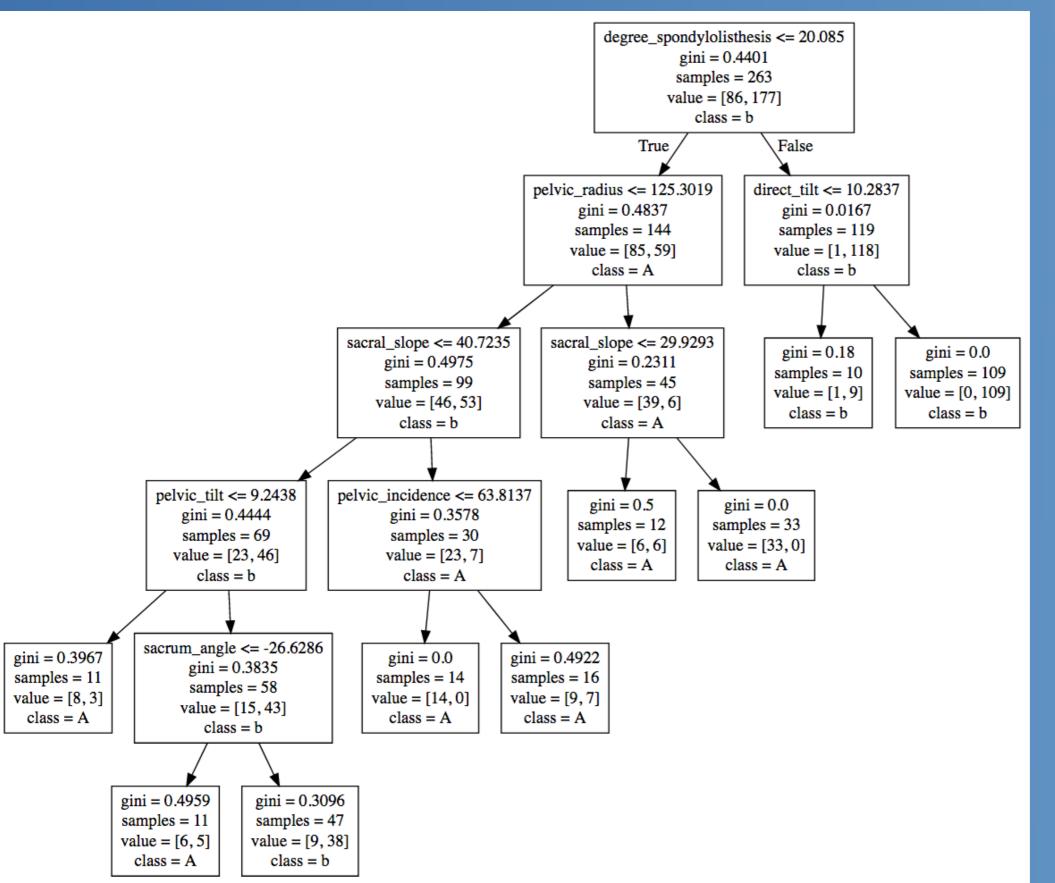
0.8 0.4 0.0 -0.4-0.8

Logistic Regression Model

Predicted with 87% accuracy.

	precision	recall	f1-score	support
0	0.81	0.83	0.82	36
1	0.91	0.90	0.90	67
avg / total	0.87	0.87	0.87	103

Decision Tree



min_samples_leaf = 10 max_depth = 5

Also 87% accurate

Further Study

More data with more "Normal" data points

Time series data - can progression to abnormal spine be "caught in its tracks?"

Movement data