Group One Final Presentation

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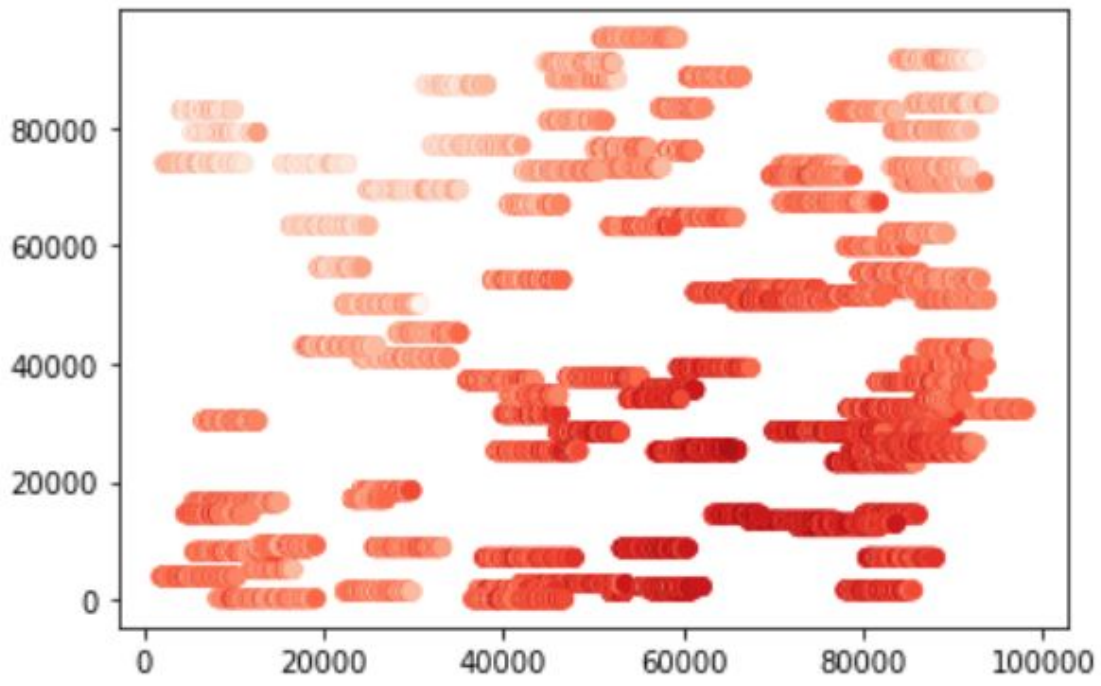
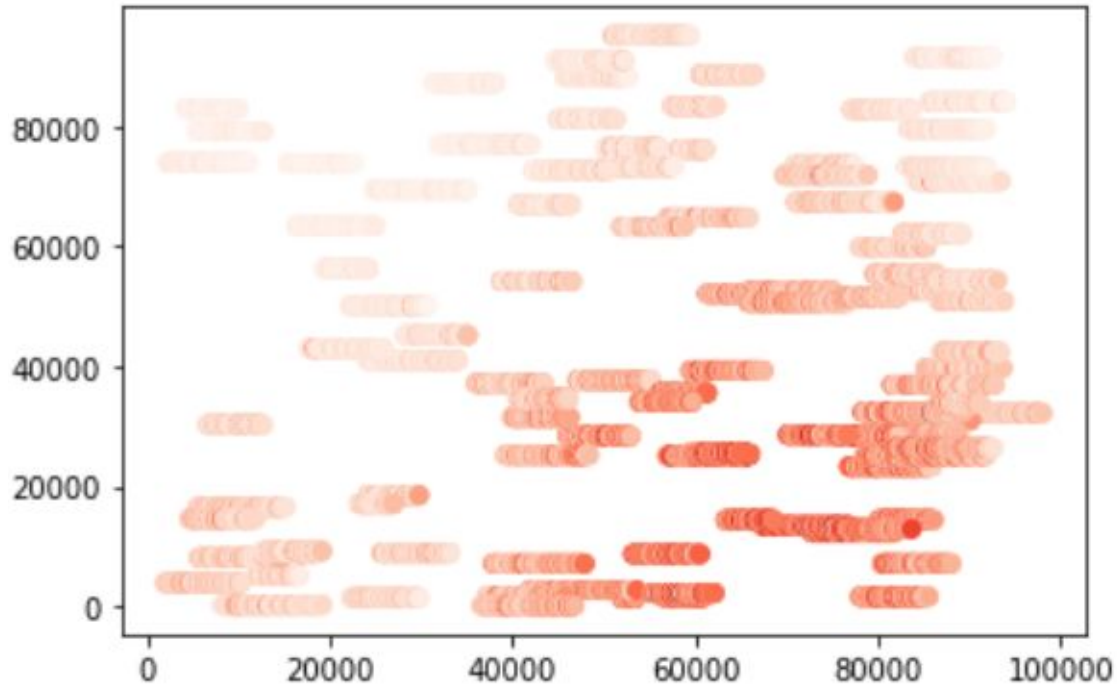
Background: Hingle Basin

- The case study is presented as a 360 square mile tract of land
- Given data spanning one year for 100 wells on the land
- From this data we are asked to predict and optimize the locations of the next set of ten wells
- Significance:
  - Good case study for practical oil and gas optimization

The Original Wells

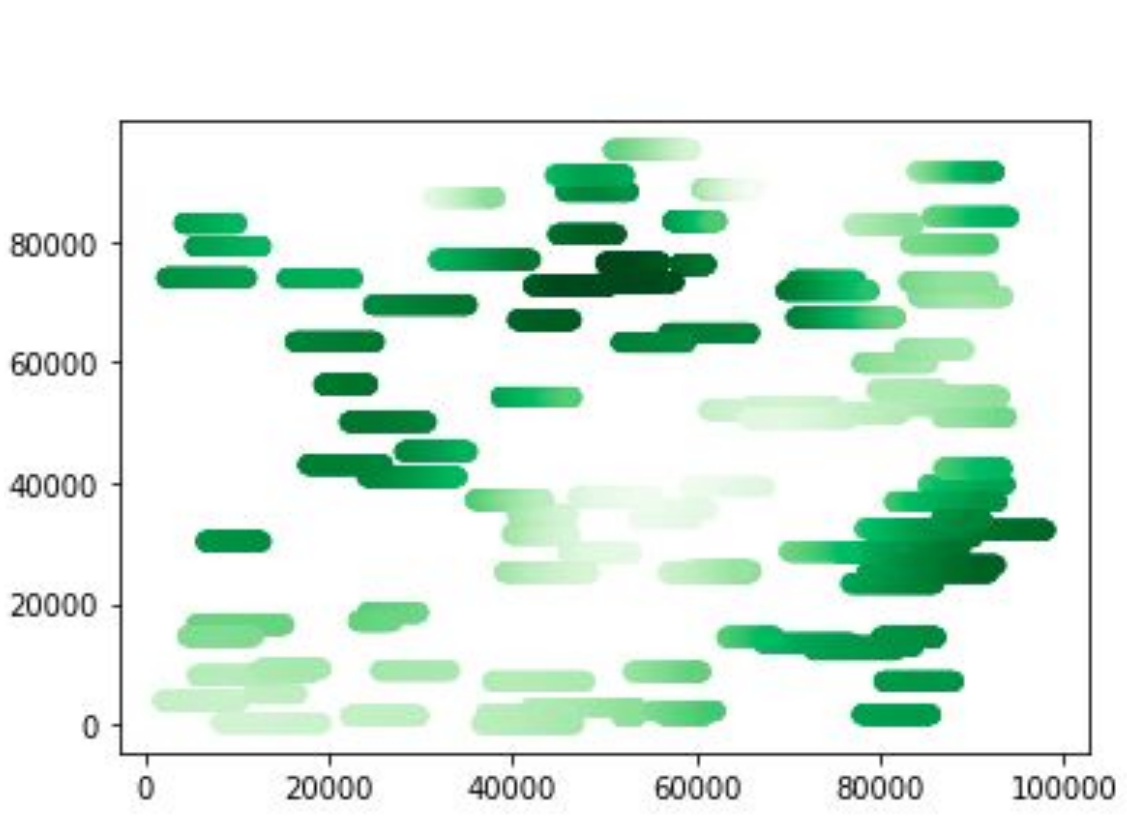


Porosity

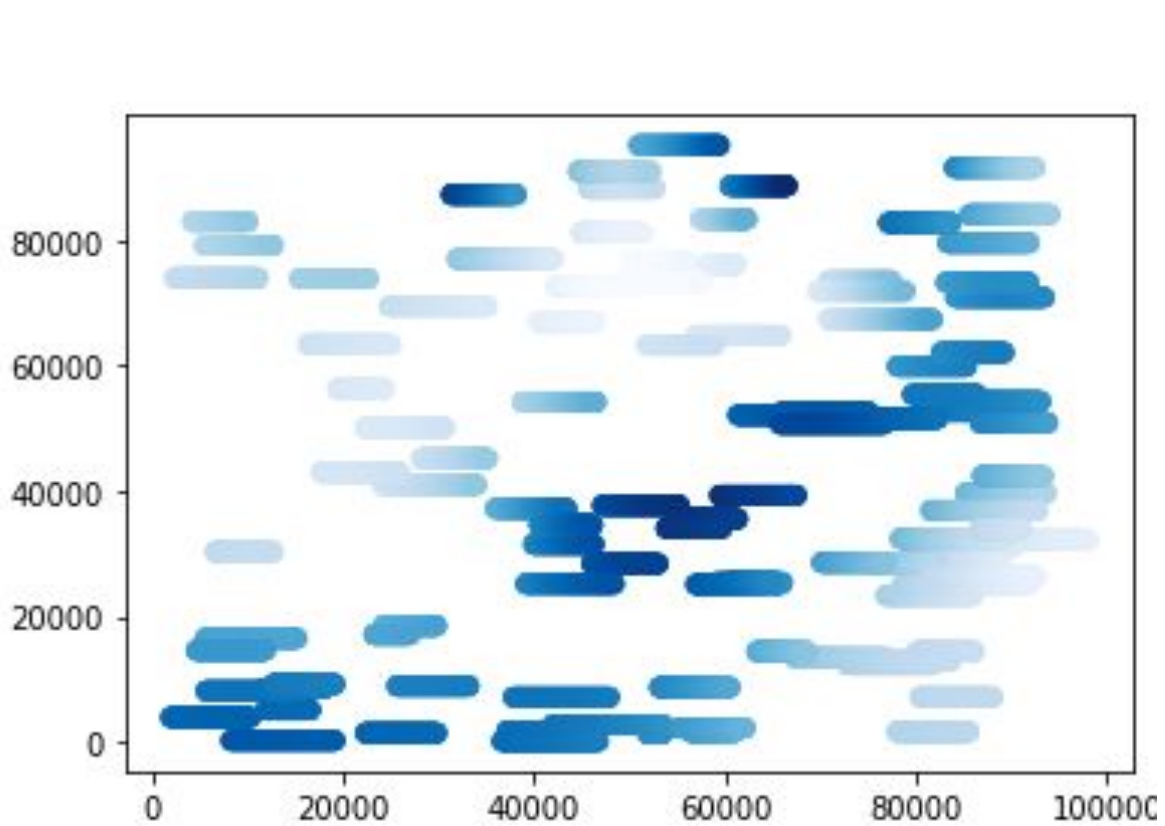


Permeability

The Original Wells



Oil Saturation



Water Saturation

Objectives Part One:

Optimize the following to maximize production:

Well length

- Based on predicted Recoverable Reserves?
- How long can a well be physically?

Number of frac stages

- What's the correlation between production and frac stages?
- How close to prevent cross interference?

Amount of proppant in each stage

- What's the correlation between production and proppant?

Pump Rate

- What's the correlation between production and pump rate?

Objectives Part Two:

Use your optimized well parameters to choose the location for the next 10 wells

Calculate the original oil in place (OOIP) for each well

- How to get a parameter for width?

Calculate the recoverable reserves (RR) for each well

- How to predict recovery factor based on other well properties?

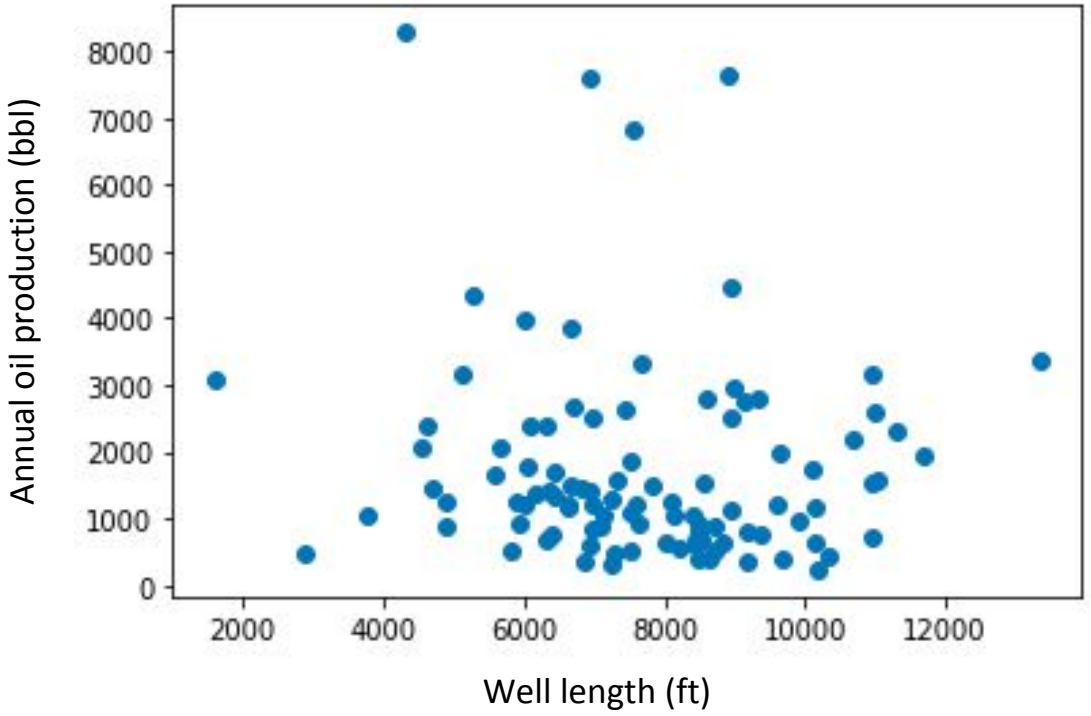
Calculate the estimated ultimate recovery (EUR) for each well

- What are the economic limits of production?
- How much does it cost to run an oil well?

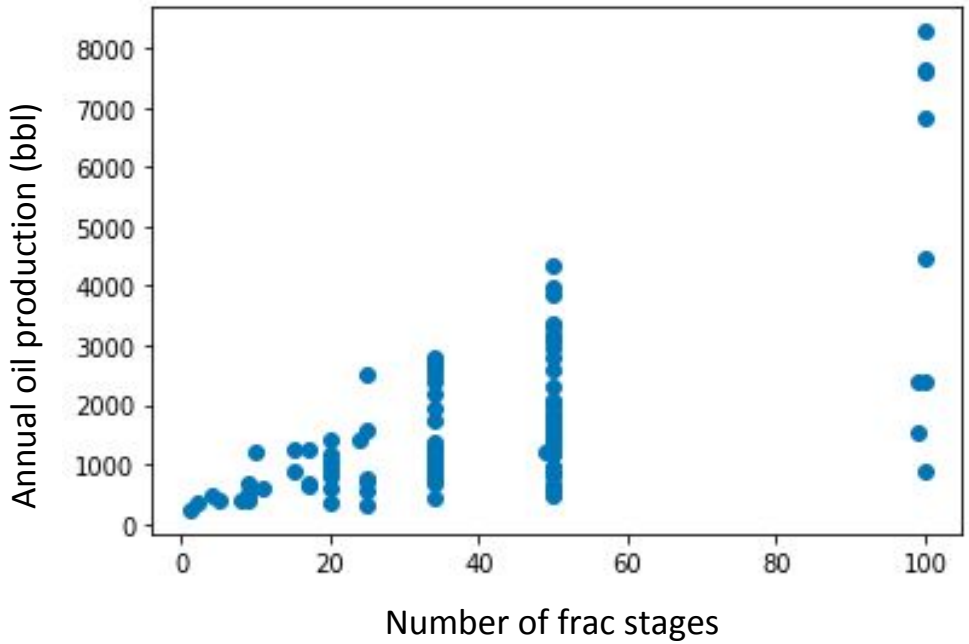
Analysis

- Pandas, Seaborn, and MatPlot for statistical analysis
- PKN fracture modeling to calculate width of thin wells
- Proppant weight, frac stages, pump rate optimization: median values
  - lack of statistical correlation between those variables and oil production

How does production vary with...

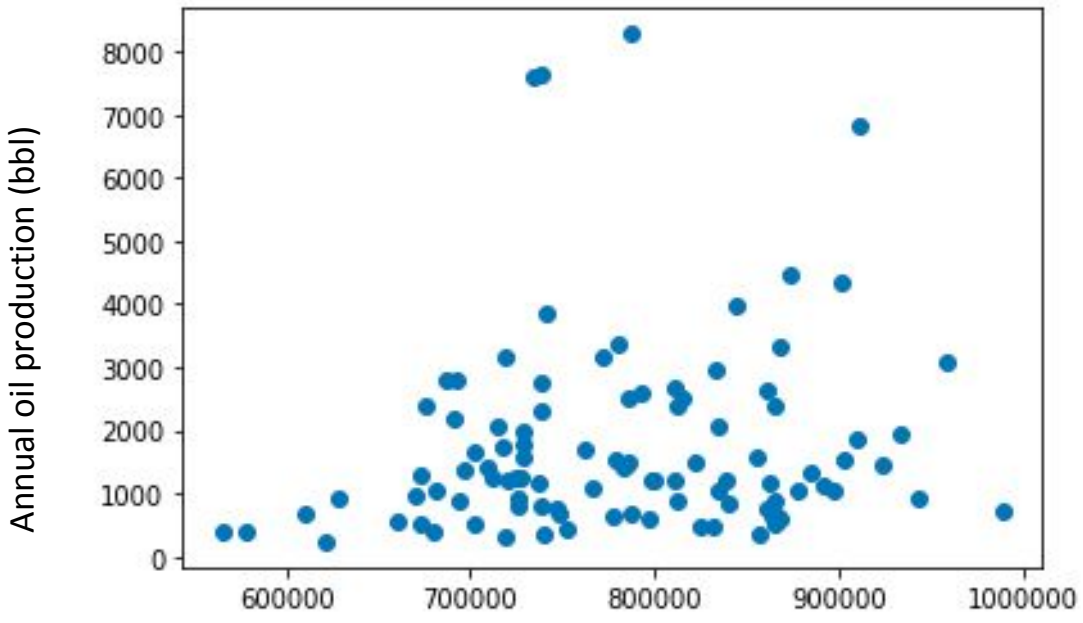


Well length

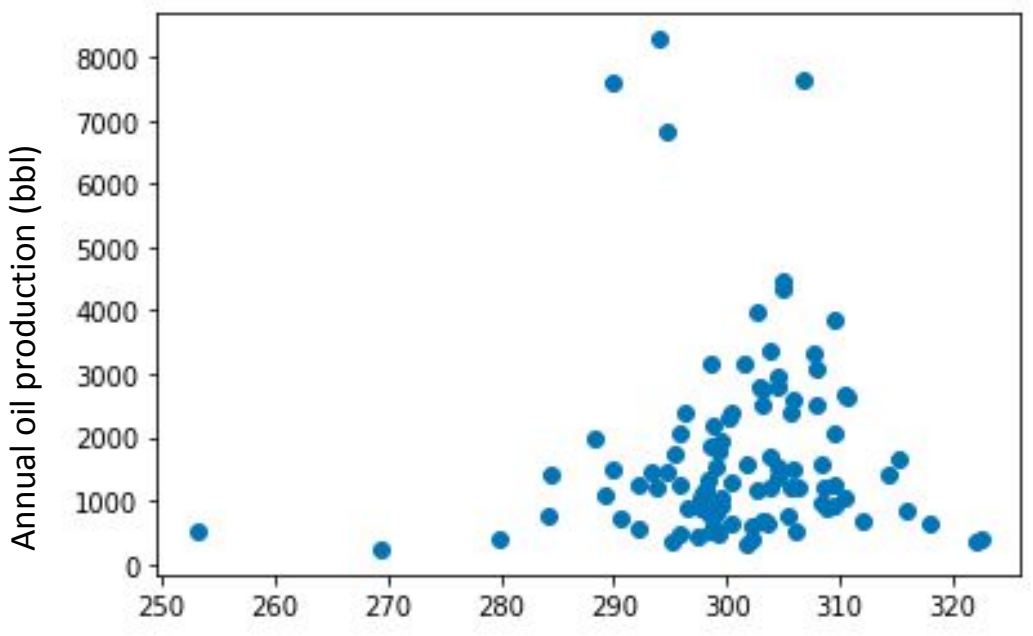


Frac stages

How does production vary with...



Proppant weight

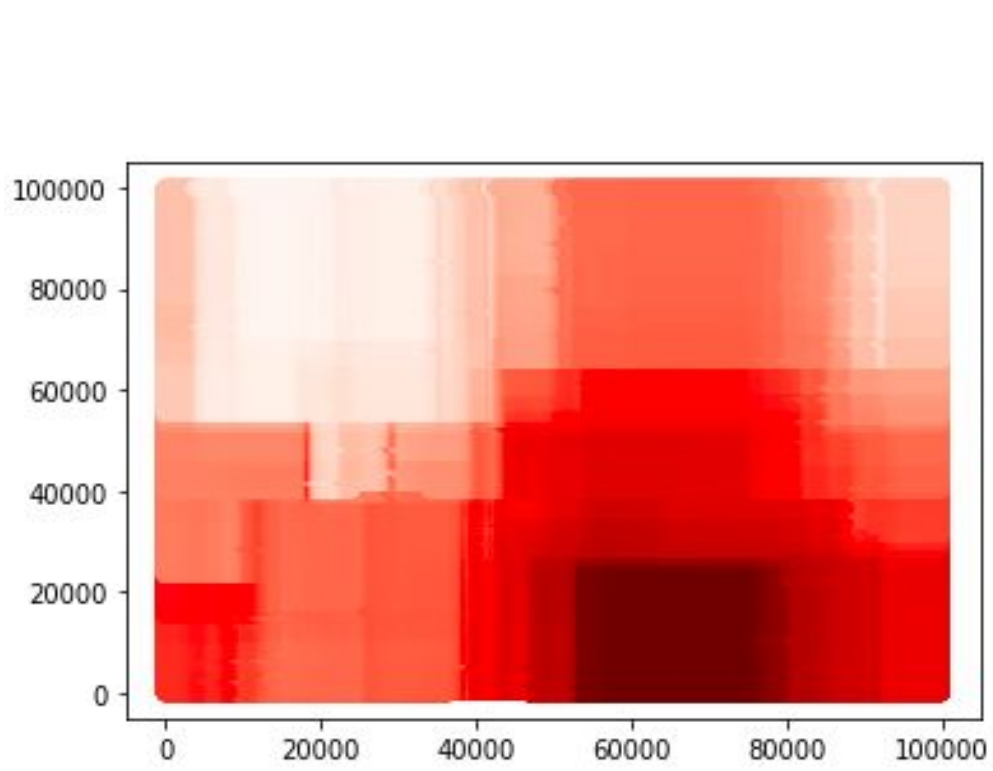


Pump Rate

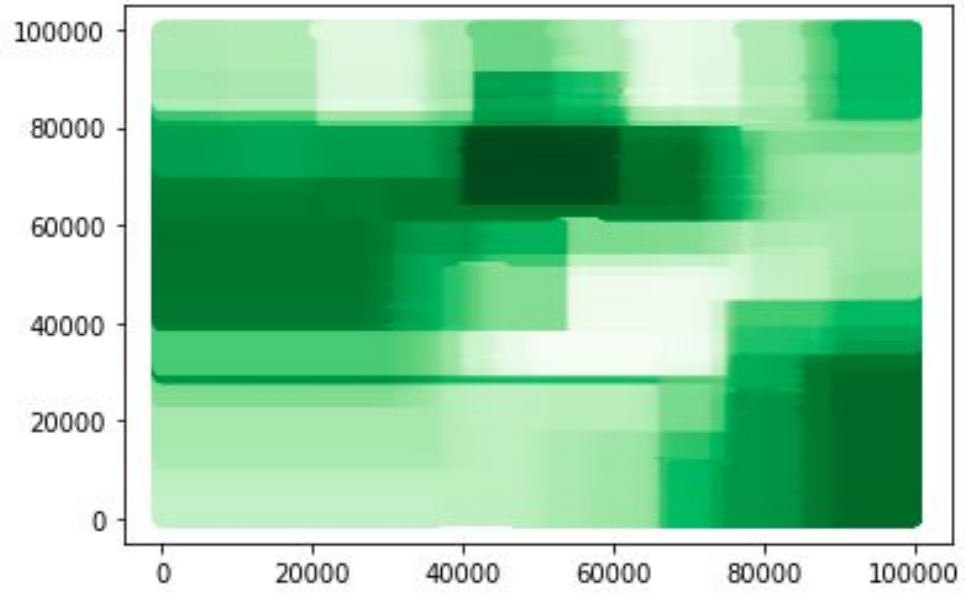
Feature Prediction: Random Tree Regression

- Predictand space constructed from unoccupied locations
- Use locations to determine well length
- Predicted data reduced to find optimal locations
  - Broke up long wells with high production potential into smaller intervals

Predictions: Random Tree Regression

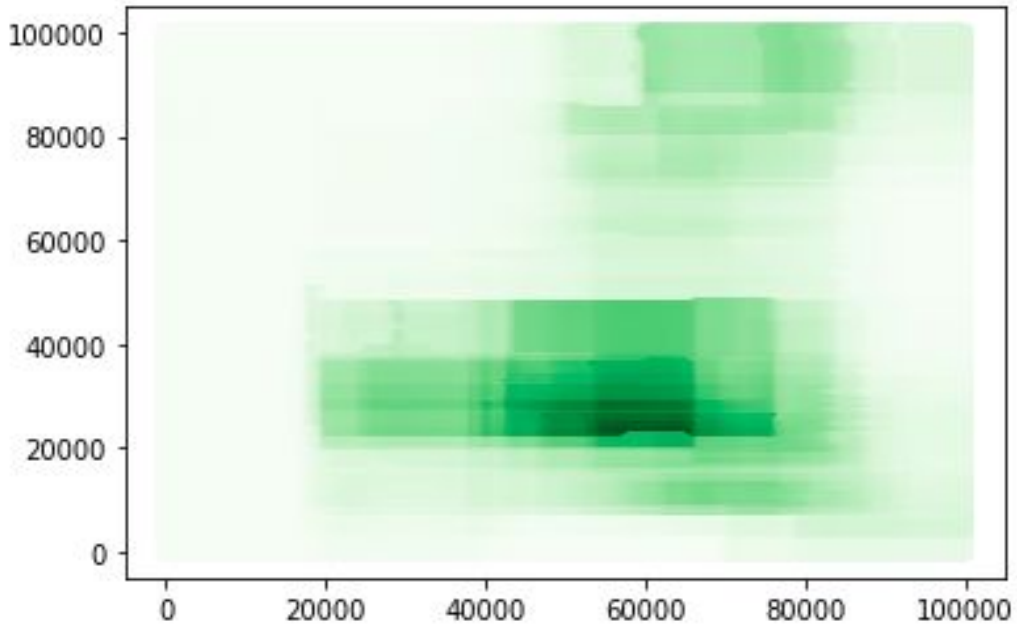


Porosity

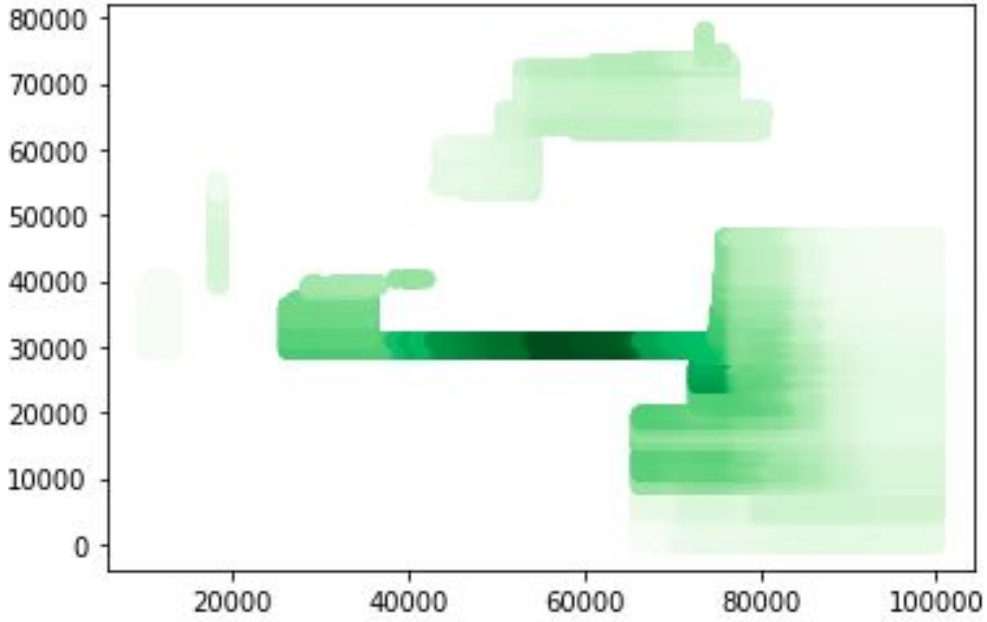


Oil Saturation

Predictions: Random Tree Regression



Recoverable Reserves



Reduced, measures above 50th percentile

Results

Northing	East Start	East End	Length	OOIP	RR	Estimated	Frac Stage	Proppant	Pump Rate
29500	52800	65900	13100	8171600	774557.9	487022.9	34	745790.2	302.8707
30900	66500	79700	13200	4727077	446746.4	402100.8	34	745790.2	302.8707
29500	66500	79700	13200	4862579	459848.2	338402.9	34	745790.2	302.8707
14500	68600	80000	11400	2947899	314897.1	201141.4	34	745790.2	302.8707
29500	39000	52100	13100	6216089	605711.5	171196.7	34	745790.2	302.8707
30900	39000	52100	13100	6197093	601322.6	171196.7	34	745790.2	302.8707
30600	26200	38700	12500	3996339	391385.3	161559.3	34	745790.2	302.8707
32100	75100	88300	13200	2719723	270235	124969.3	34	745790.2	302.8707
13100	66300	75000	8700	2294606	246752.1	121545.1	34	745790.2	302.8707
27000	72800	81600	8800	3041987	294599.7	114899.6	34	745790.2	302.8707

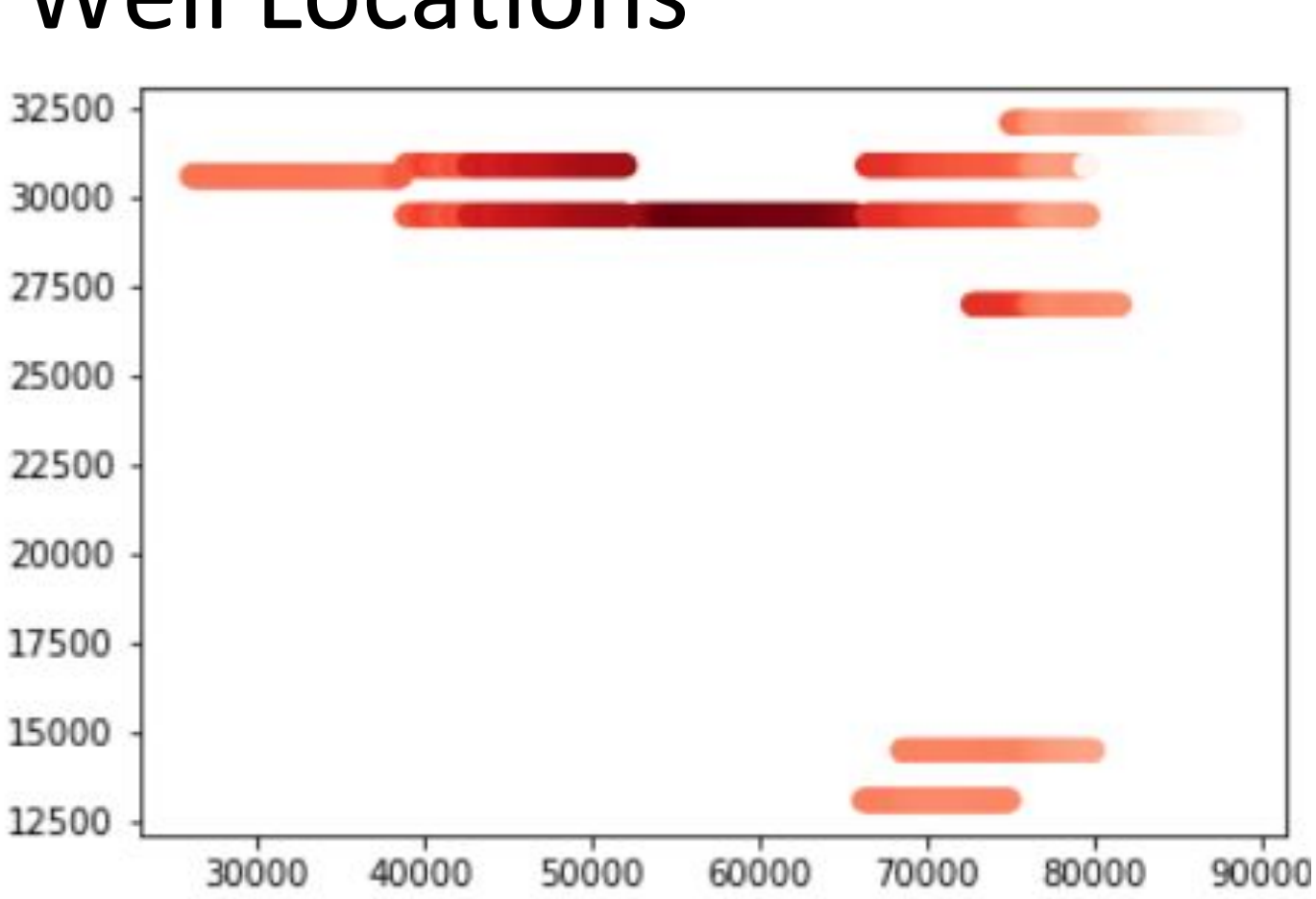
Results

Summed oil in place: 45.17 MM bbl

Summed recoverable reserves: 4.41 MM bbl

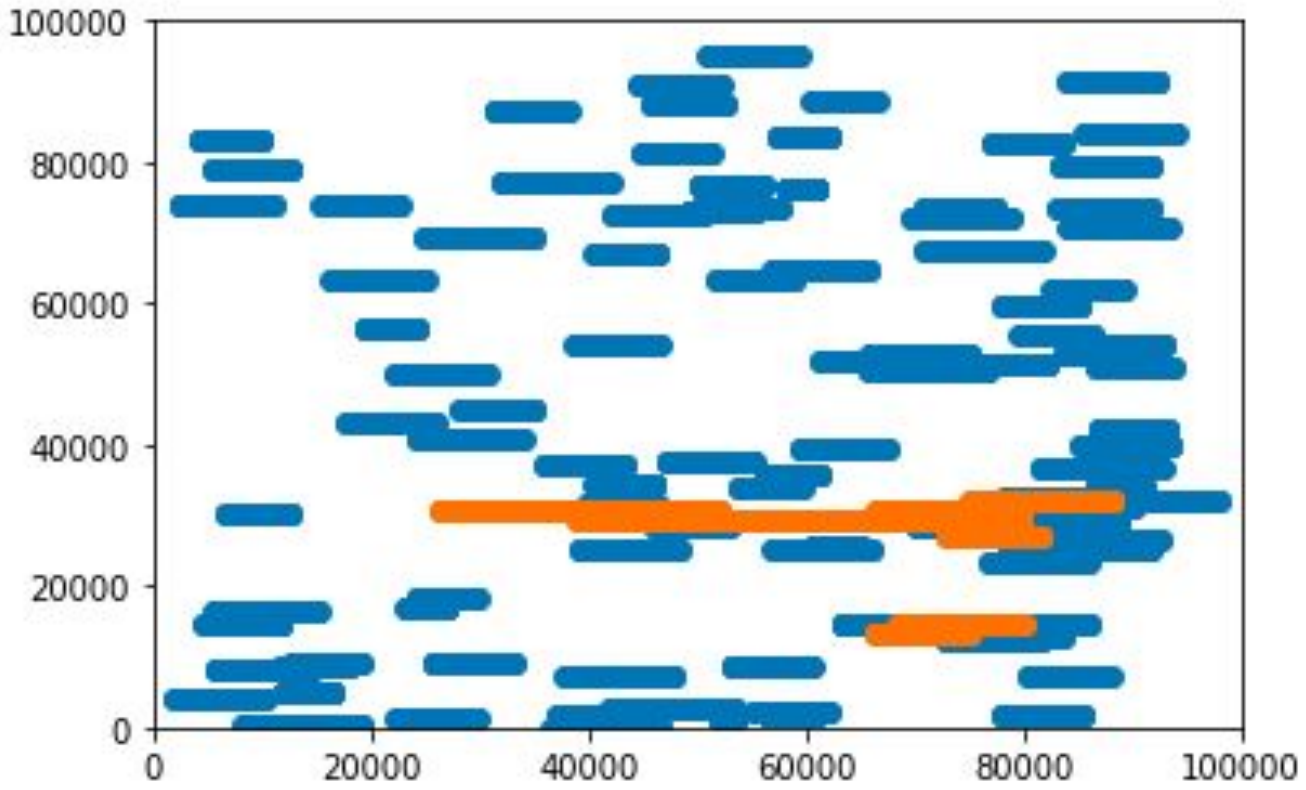
Summed estimated ultimate recovery: 2.28 MM bbl

Map of Well Locations*

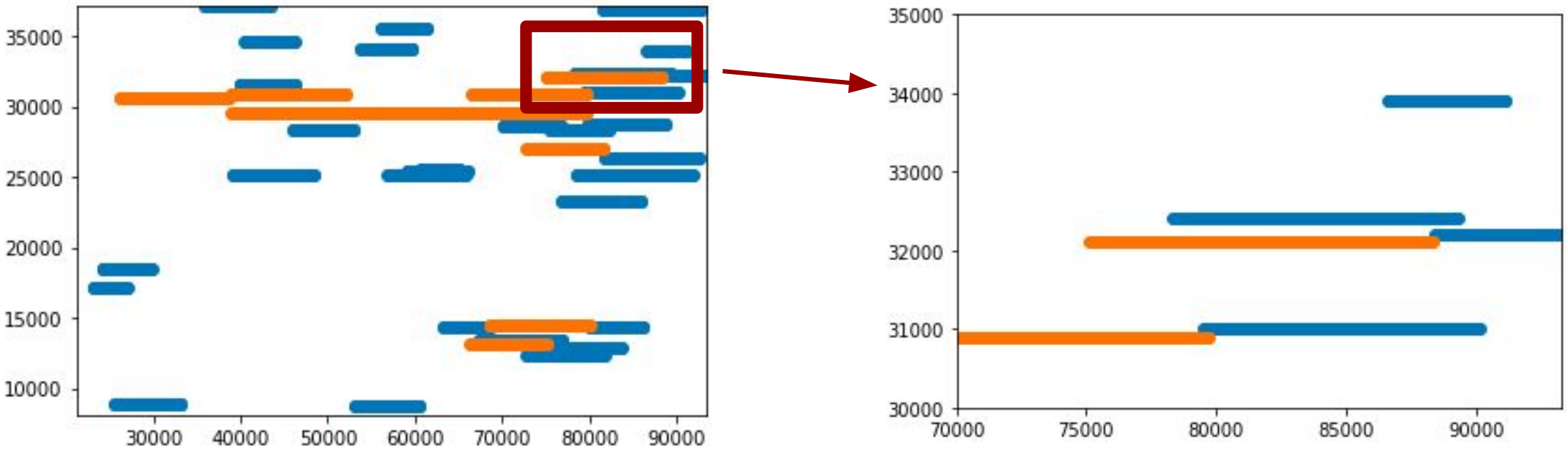


*Colored by recoverable reserves

Map of Well Locations



Map of Well Locations



(they do not overlap with existing wells)

Conclusions

- There is a region located in the lower center of the basin where there is predicted to be a high amount of recoverable reserves
- The wells are expected to have an average lifetime of 5.09 years before they reach the estimated economic limit of production
- The lifetime of the wells is short because the Hingle basin is an unconventional play
- The investment in these ten wells is expected to have a net profit of 25 million dollars per year after the estimated cost of the wells