Quantum ML vs Classical ML

A comparative analysis of quantum machi## Modelsne learning and classical machine learning

Performance Metrics Results

F1 Results

Model	diabetes		predictive maintenance		raisin		room	
	F1 Train	F1 Test	F1 Train	F1 Test	F1 Train	F1 Test	F1 Train	F1 Test
Logistic Regression	0.6983	0.6387	0.8145	0.2166	0.8608	0.8506	0.9862	0.9657
Naive Bayes	0.6748	0.6400	0.8321	0.2000	0.8214	0.8176	0.9656	0.9409
Decision Tree	0.7588	0.6241	0.9408	0.3003	0.9208	0.8263	0.9962	0.9812
Random Forest	0.9173	0.6772	0.9364	0.2931	0.9162	0.8488	0.9987	0.9708
SVC	0.8405	0.6364	0.9143	0.3283	0.8763	0.8521	0.9869	0.9657
QSVC	0.9644	0.6000	0.9581	0.2880	0.8816	0.8439	0.9869	0.9683
Pegasos QSVC	0.7797	0.6102	0.7853	0.2786	0.8537	0.8696	0.9766	0.9622
VQC	0.4108	0.3721	0.7270	0.1189	0.8230	0.8313	0.8660	0.8265

Precision Results

Model	diabetes		predictive maintenance		raisin		room	
	Prec Train	Prec Test	Prec Train	Prec Test	Prec Train	Prec Test	Prec Train	Prec Test
Logistic Regression	0.7447	0.5938	0.8235	0.1244	0.8912	0.8409	0.9740	0.9337
Naive Bayes	0.6985	0.5714	0.8444	0.1161	0.9244	0.8904	0.9358	0.8883
Decision Tree	0.7119	0.5116	0.9391	0.1815	0.9874	0.8519	0.9937	0.9632
Random Forest	0.9238	0.5972	0.9201	0.1738	0.9665	0.8488	0.9975	0.9433
SVC	0.9121	0.6364	0.9078	0.2015	0.9319	0.8675	0.9741	0.9337
QSVC	0.9760	0.4941	0.9705	0.1720	0.9169	0.8391	0.9741	0.9385
Pegasos QSVC	0.6509	0.4426	0.9100	0.1781	0.8346	0.8163	0.9736	0.9519
VQC	0.7262	0.5161	0.7037	0.0645	0.8640	0.8625	0.8677	0.7751

Recall Results

Model	diabetes		predictive maintenance		raisin		room	
	Recall Train	Recall Test	Recall Train	Recall Test	Recall Train	Recall Test	Recall Train	Recall Test
Logistic Regression	0.6573	0.6909	0.8058	0.8361	0.8324	0.8605	0.9987	1.0000
Naive Bayes	0.6526	0.7273	0.8201	0.7213	0.7390	0.7558	0.9975	1.0000
Decision Tree	0.8122	0.8000	0.9424	0.8689	0.8626	0.8023	0.9987	1.0000
Random Forest	0.9108	0.7818	0.9532	0.9344	0.8709	0.8488	1.0000	1.0000
SVC	0.7793	0.6364	0.9209	0.8852	0.8269	0.8372	1.0000	1.0000
QSVC	0.9531	0.7636	0.9460	0.8852	0.8489	0.8488	1.0000	1.0000
Pegasos QSVC	0.9718	0.9818	0.6906	0.6393	0.8736	0.9302	0.9797	0.9727
VQC	0.2864	0.2909	0.7518	0.7541	0.7857	0.8023	0.8644	0.8852

Runtime Results

Model	diabetes	predictive maintenance	raisin	room
Logistic Regression	0.010675	0.018321	0.014716	0.015601
Naive Bayes	0.004743	0.005234	0.004888	0.005849
Decision Tree	0.005158	0.005781	0.008134	0.007999
Random Forest	0.092609	0.067111	0.197358	0.112706
SVC	0.163556	0.018017	0.107552	0.027467
QSVC	10,798.149189	1,816.435473	10,124.409601	41,142.298698
Pegasos QSVC	372.593309	146.039537	933.720333	70.398480
VQC	5,102.376253	4,476.214997	3,433.498191	4,354.364534

Optimal Parameters

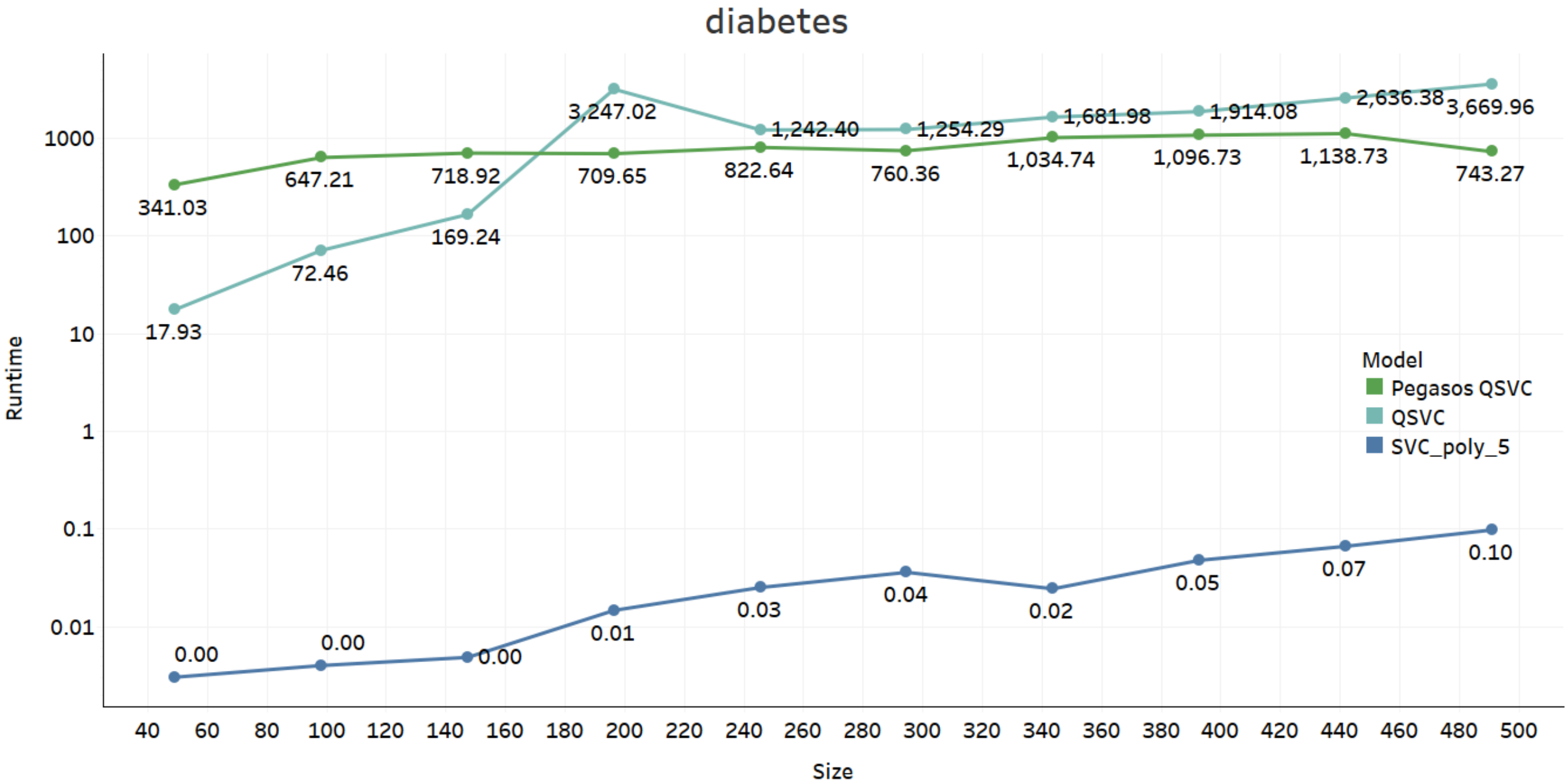
Optimal Parameter Results

Model	diabetes	predictive maintenance	raisin	room
Decision Tree	max_depth = 3 | max_features = 3	max_depth = 4 | max_features = 6	max_depth = 5 | max_features = 7	max_depth = 5 | max_features = 4
Logistic Regression	penalty = "l1" | C = 0.667	penalty = "l1" | C = 1.0	penalty = "l2" | C = 1.0	penalty = "l1" | C = 1.0
Naïve Bayes	N/A	N/A	N/A	N/A
Pegasos QSVC	tau = 300 | C = 200	tau = 300 | C = 750	tau = 400 | C = 100	tau = 300 | C = 750
QSVC	N/A	N/A	N/A	N/A
Random Forest	max_depth = 6 | max_features = 4 | n_estimators = 30	max_depth = 4 | max_features = 6 | n_estimators = 20	max_depth = 4 | max_features = 6 | n_estimators = 50	max_depth = 5 | max_features = 4 | n_estimators = 30
SVC	kernel = "poly" | degree = 5	kernel = "poly" | degree = 3	kernel = "poly" | degree = 5	kernel = "poly" | degree = 3
VQC	optimizer = "cobyla" | ansatz = "su2" | reps = 1	optimizer = "spsa" | ansatz = "su2" | reps = 2	optimizer = "cobyla" | ansatz = "su2" | reps = 2	optimizer = "cobyla" | ansatz = "su2" | reps = 2

Diabetes

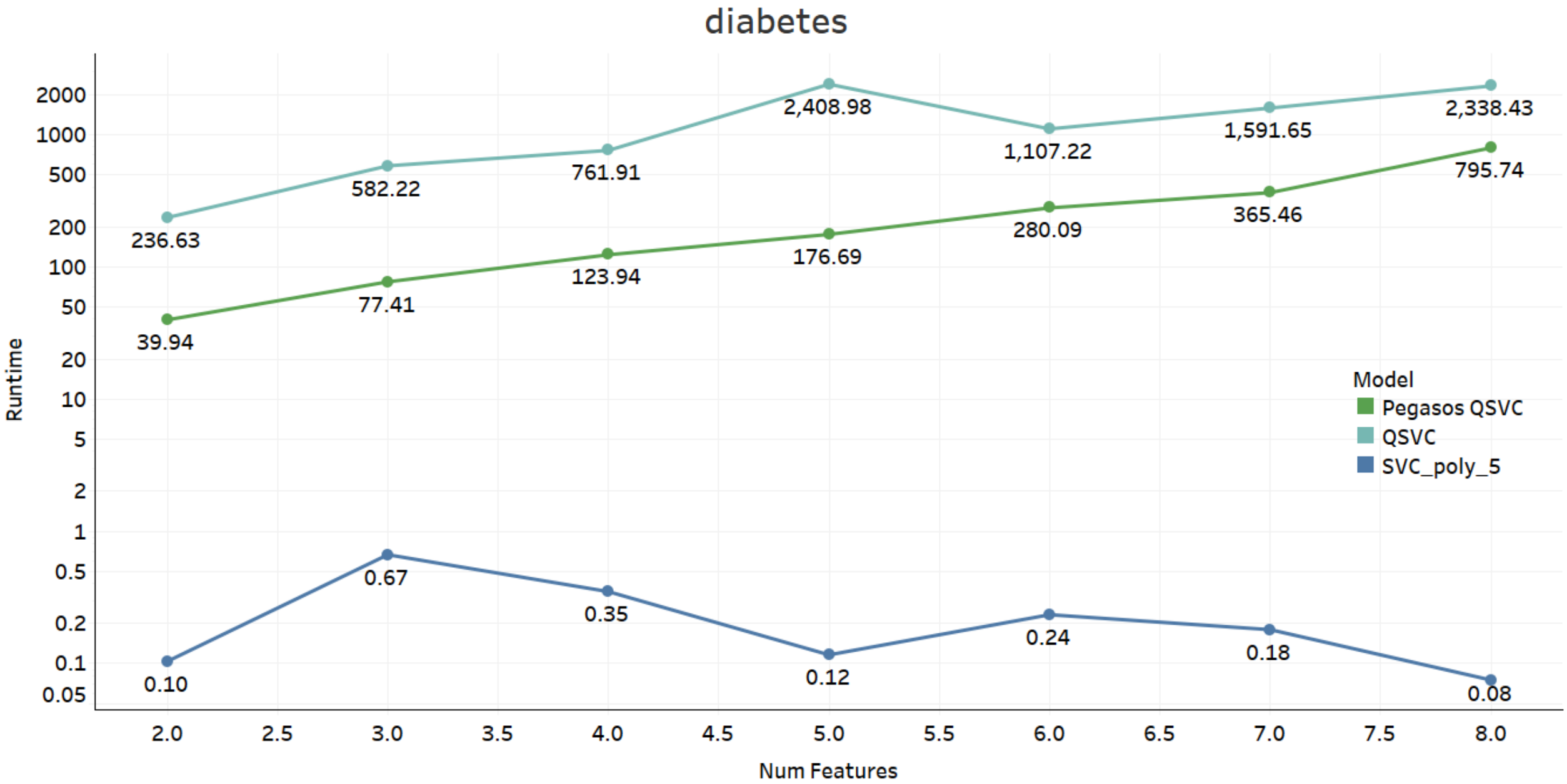
SVC Family - Runtime vs Number of Observations

diabetes



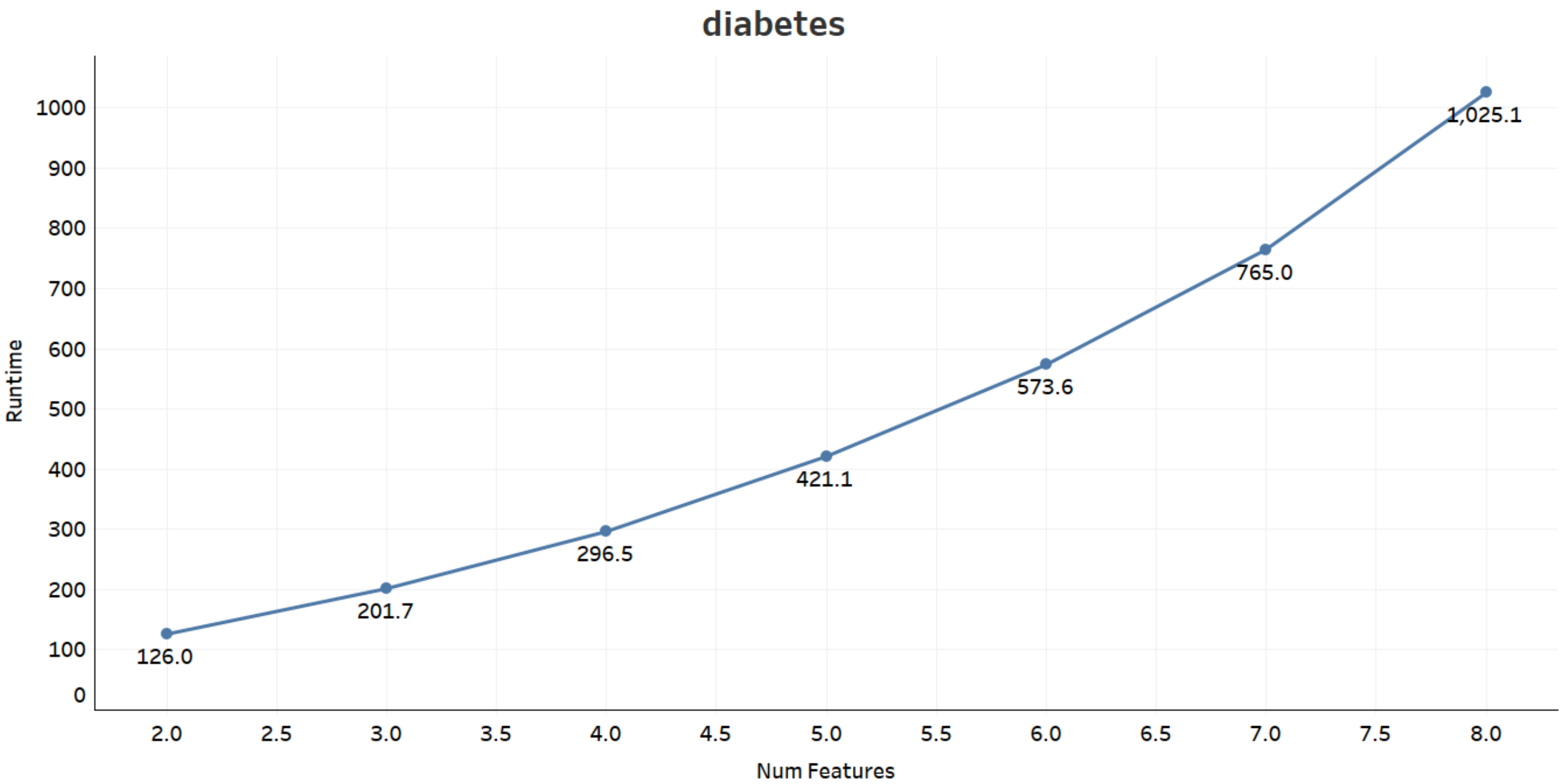
SVC Family - Runtime vs Number of Features

diabetes



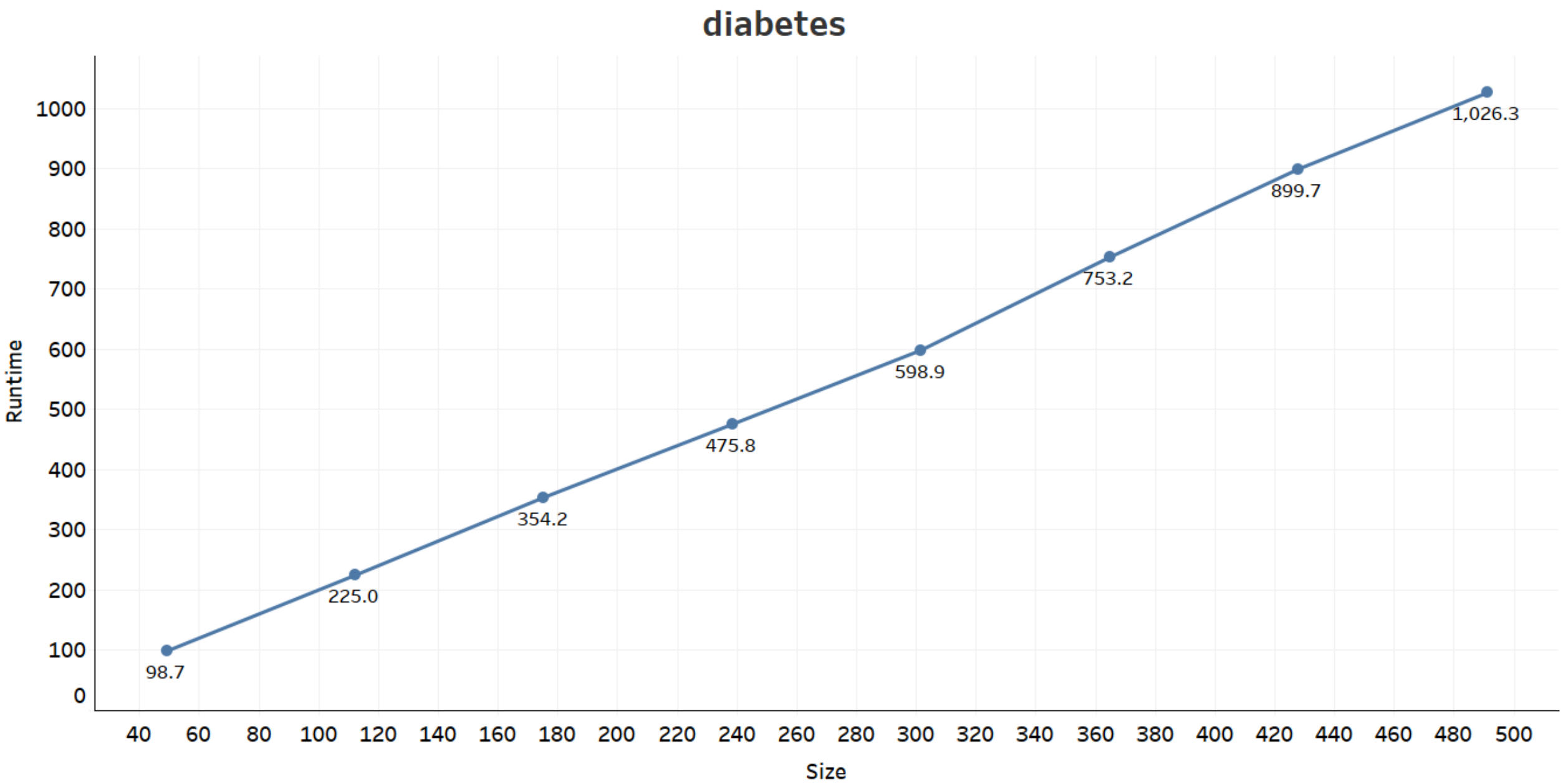
VQC - Runtime vs Number of Features

diabetes



VQC - Runtime vs Number of Observations

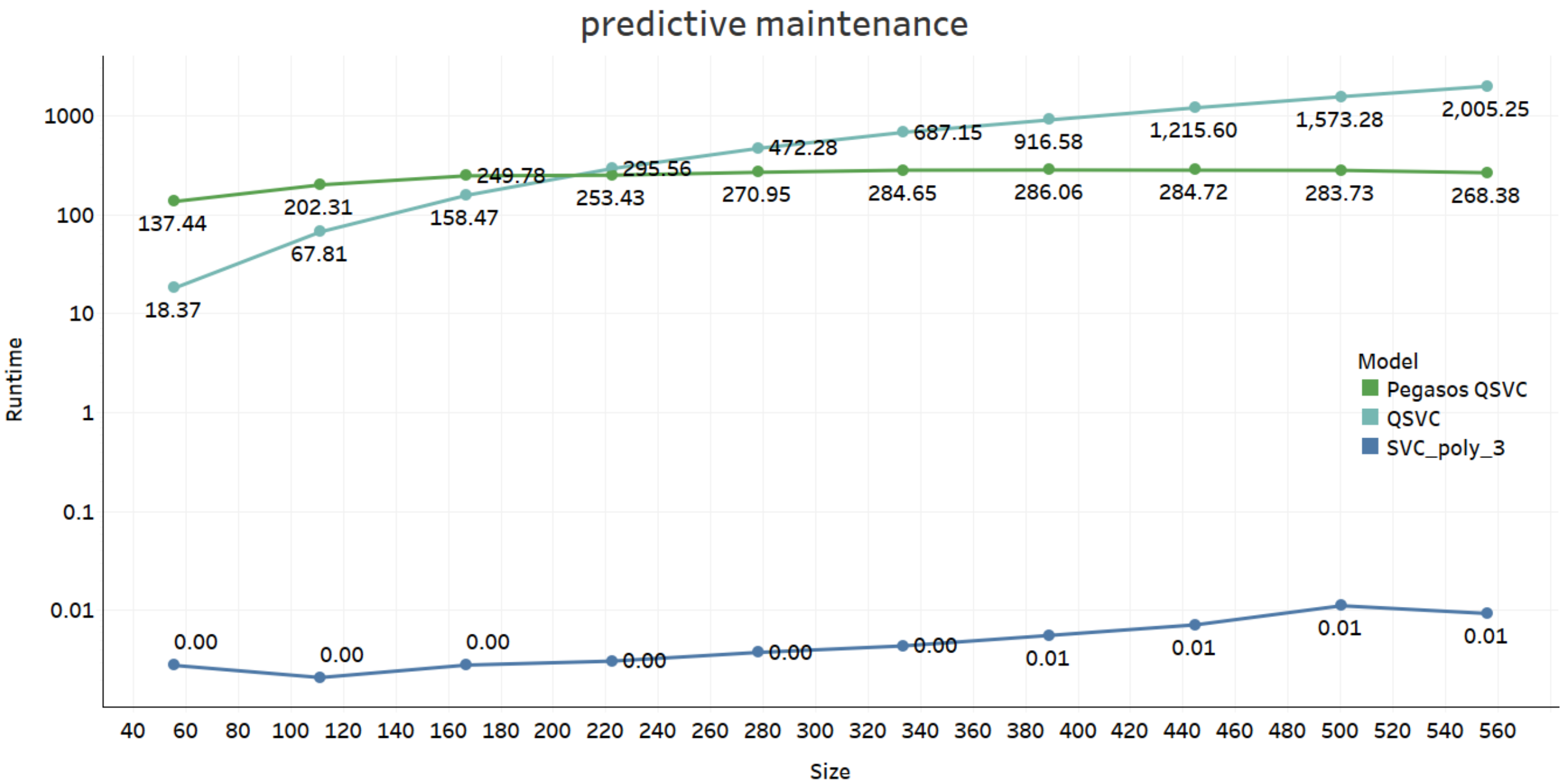
diabetes



Predictive Maintenance

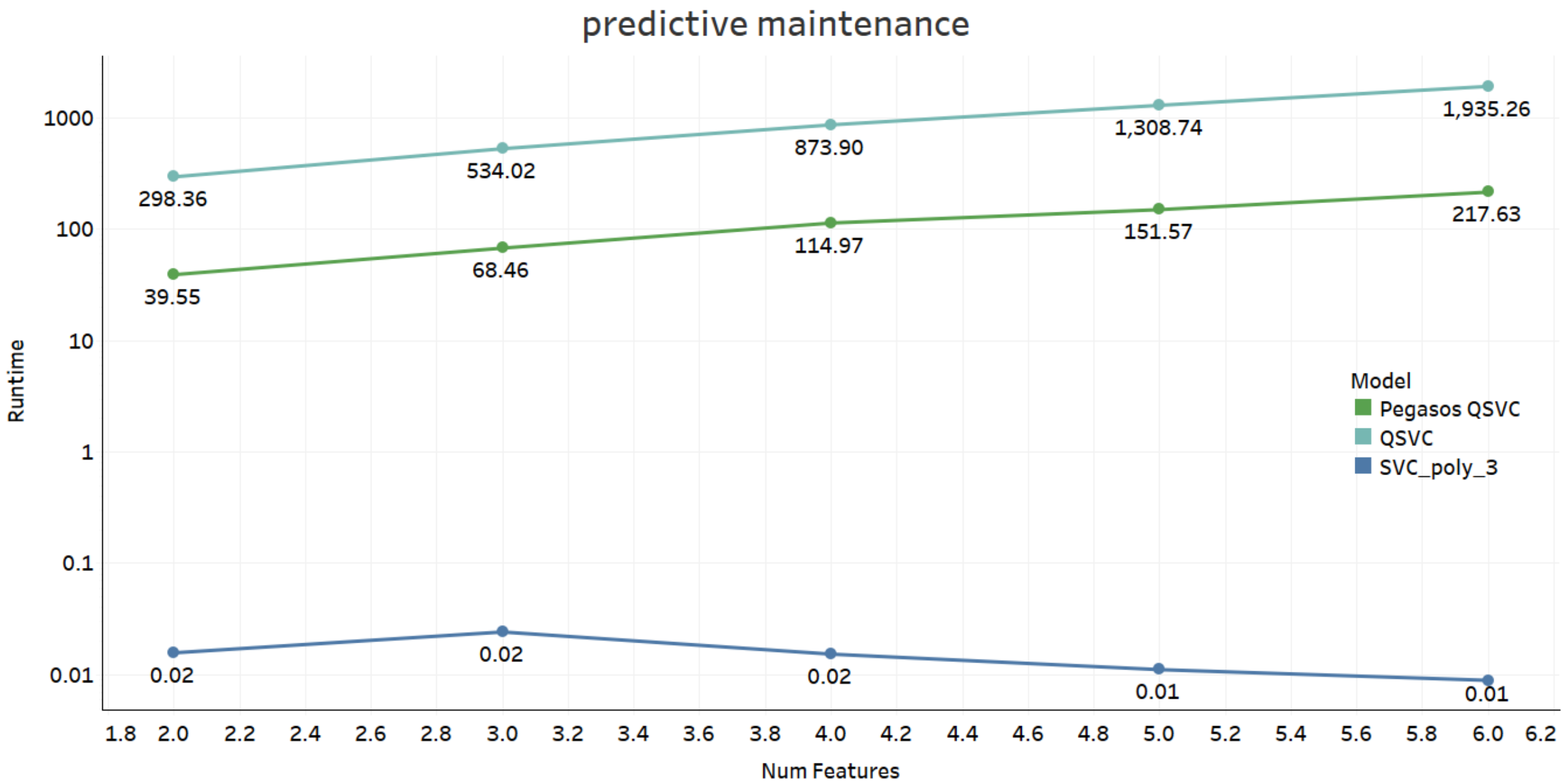
SVC Family - Runtime vs Number of Observations

predictive mainte..



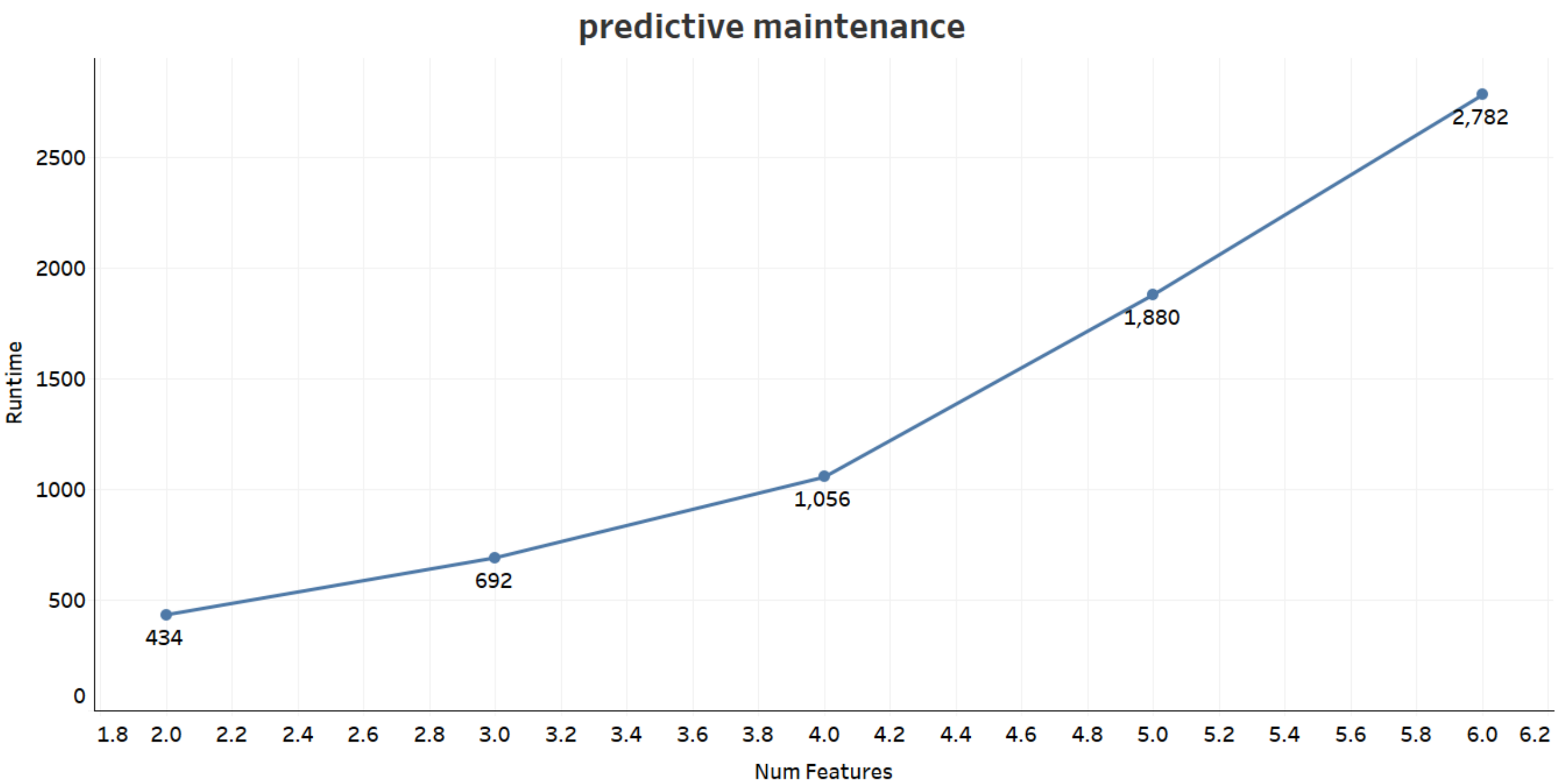
SVC Family - Runtime vs Number of Features

predictive maint..



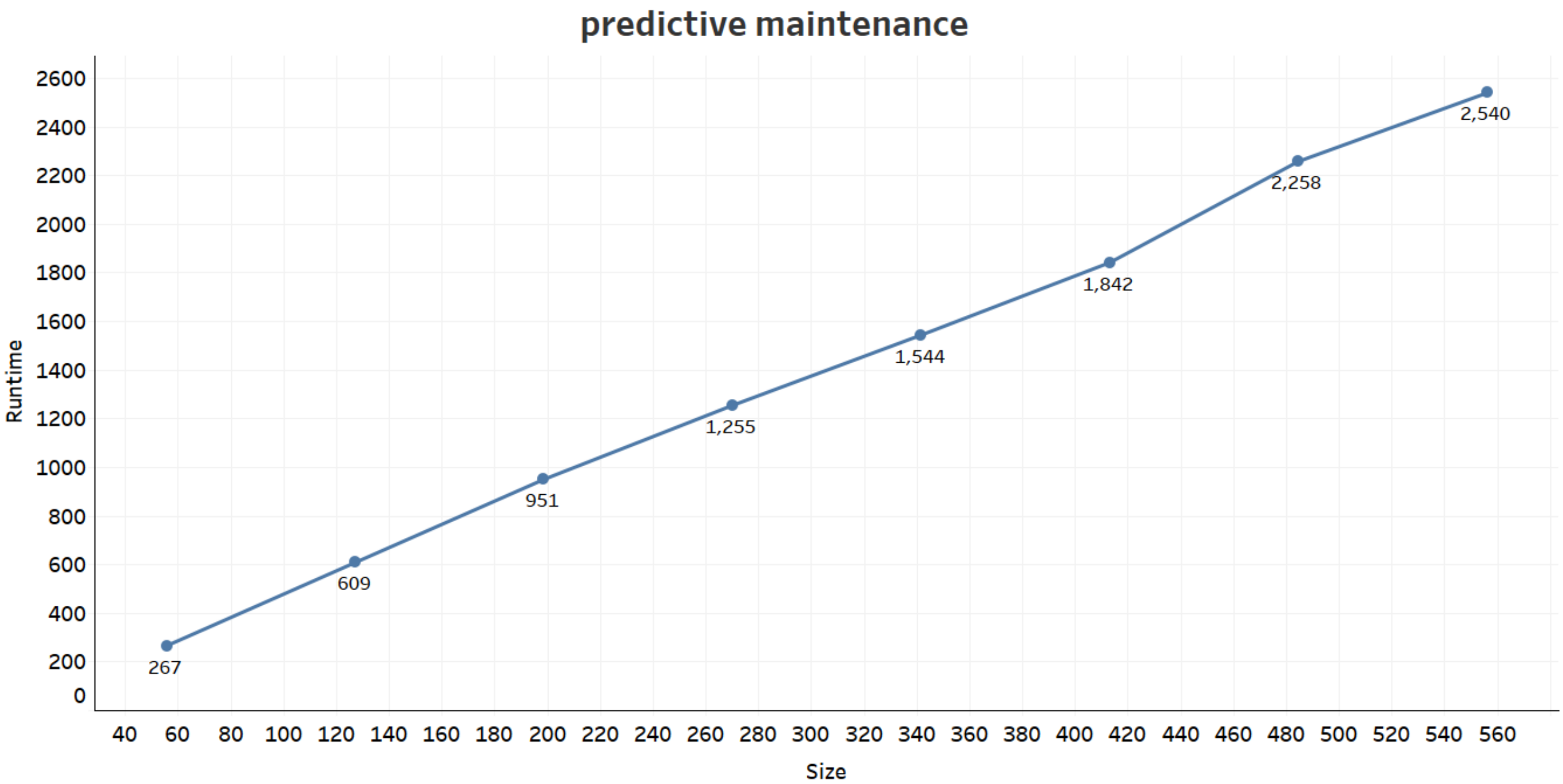
VQC - Runtime vs Number of Features

predictive maint..



VQC - Runtime vs Number of Observations

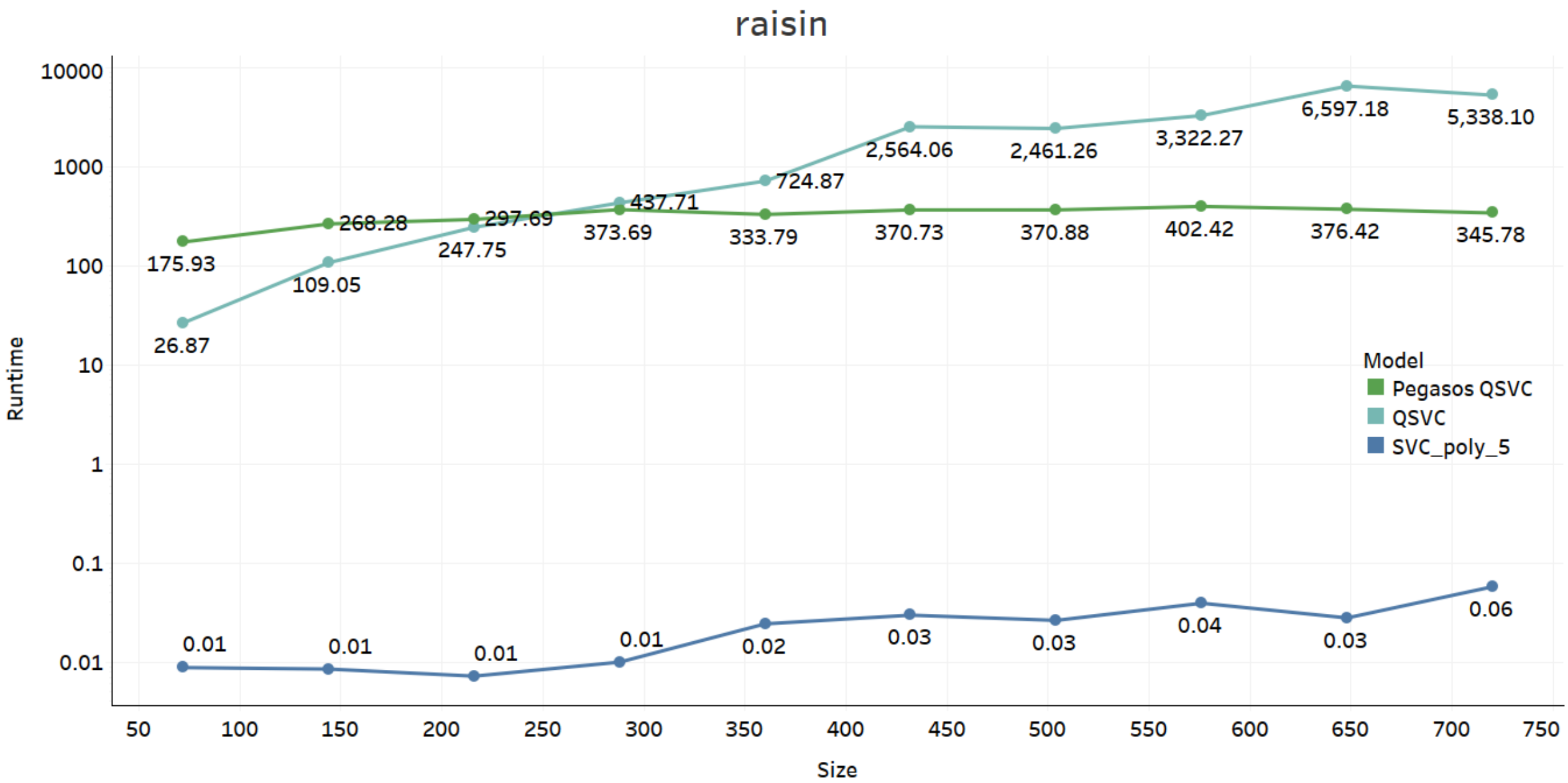
predictive maint..



Raisin

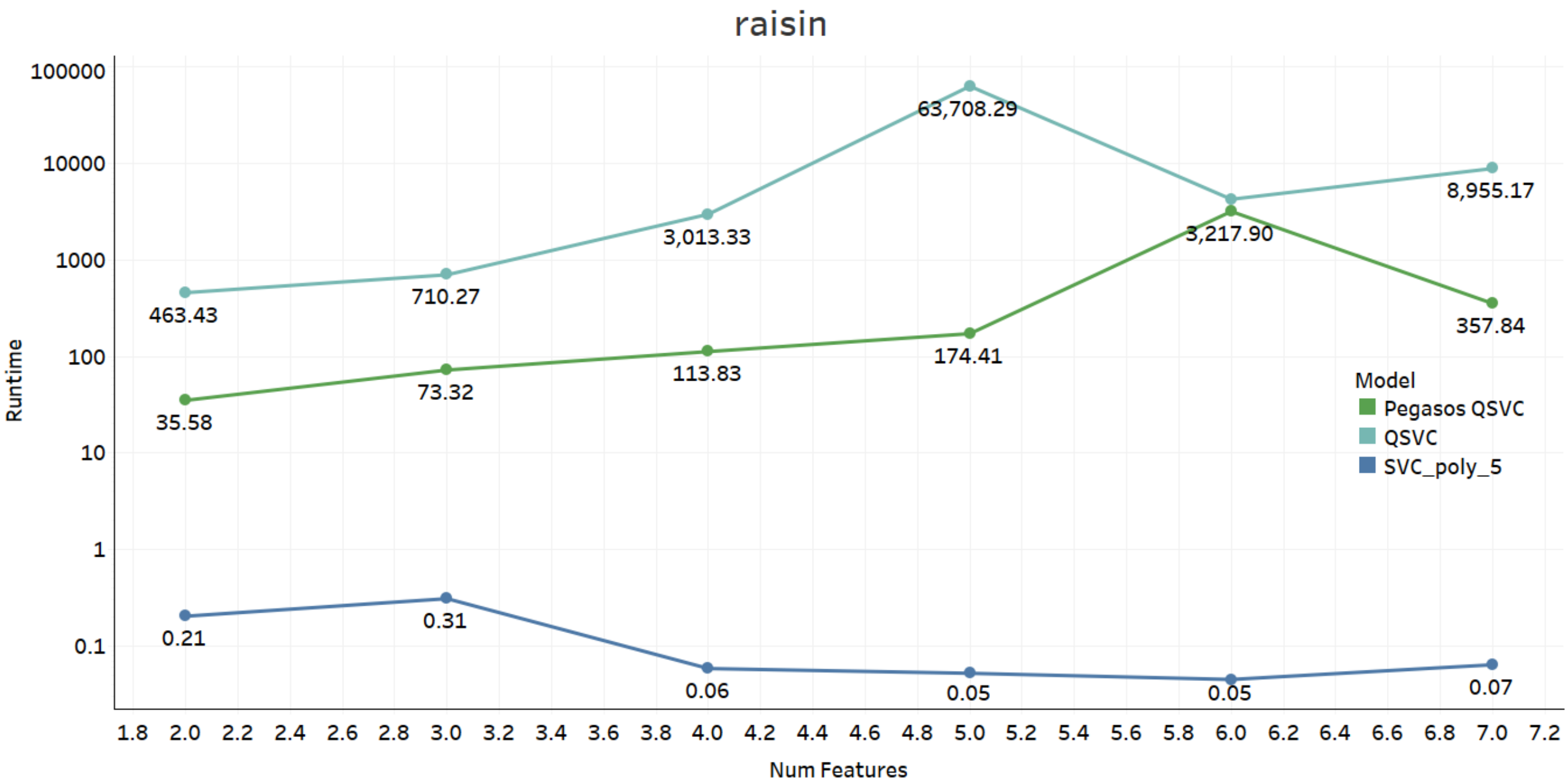
SVC Family - Runtime vs Number of Observations

raisin



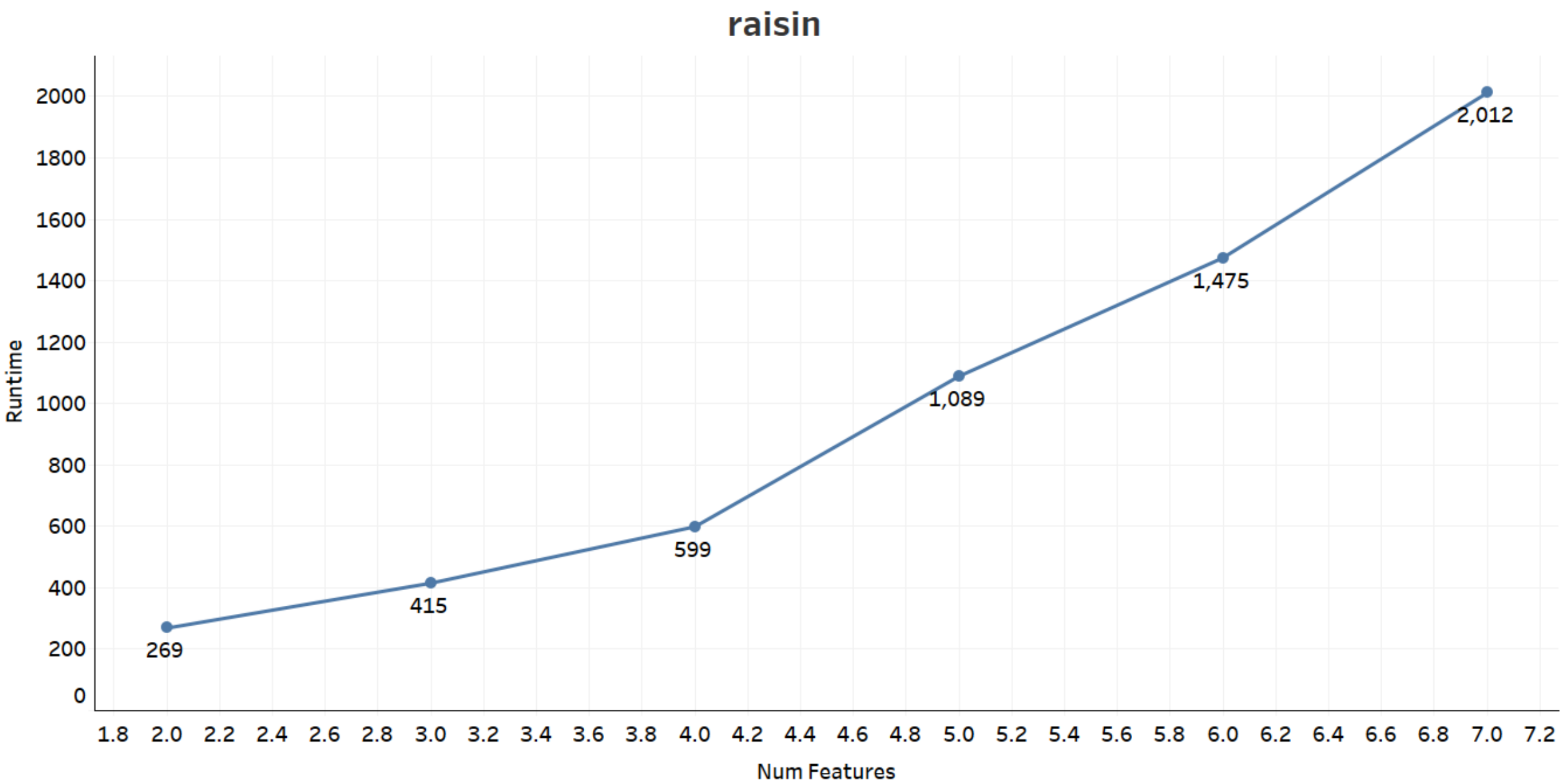
SVC Family - Runtime vs Number of Features

raisin



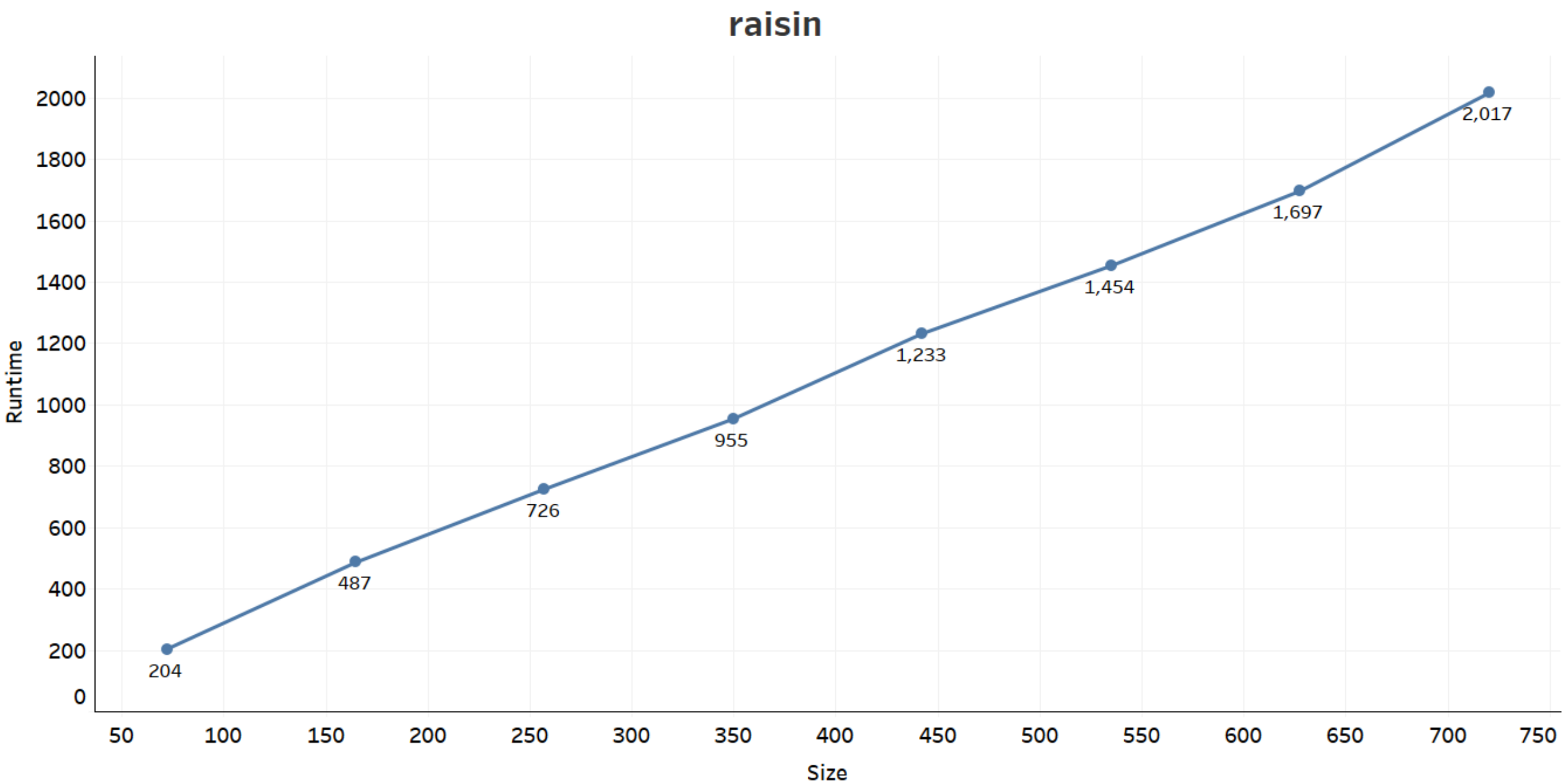
VQC - Runtime vs Number of Features

raisin



VQC - Runtime vs Number of Observations

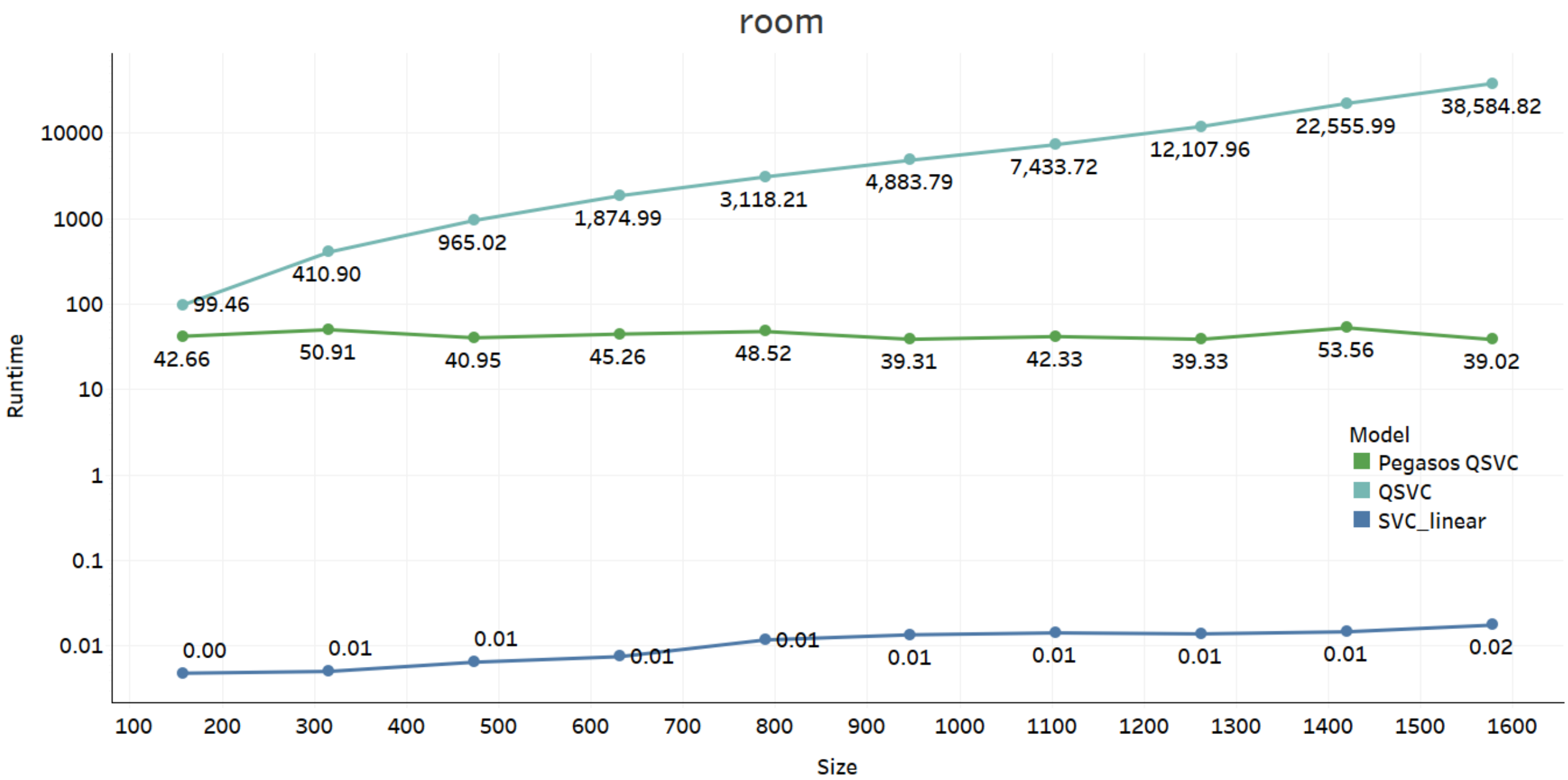
raisin



Room

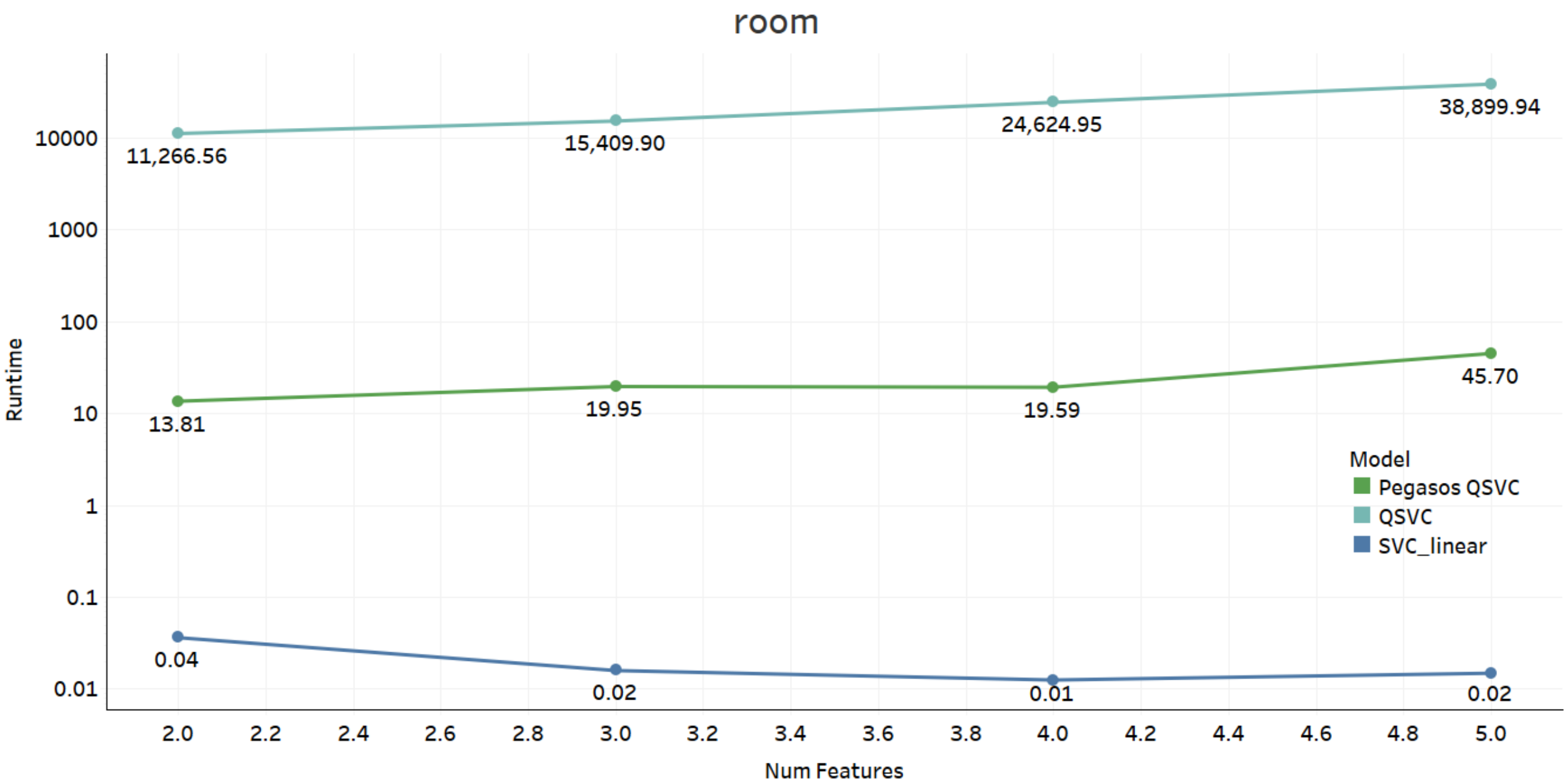
SVC Family - Runtime vs Number of Observations

room



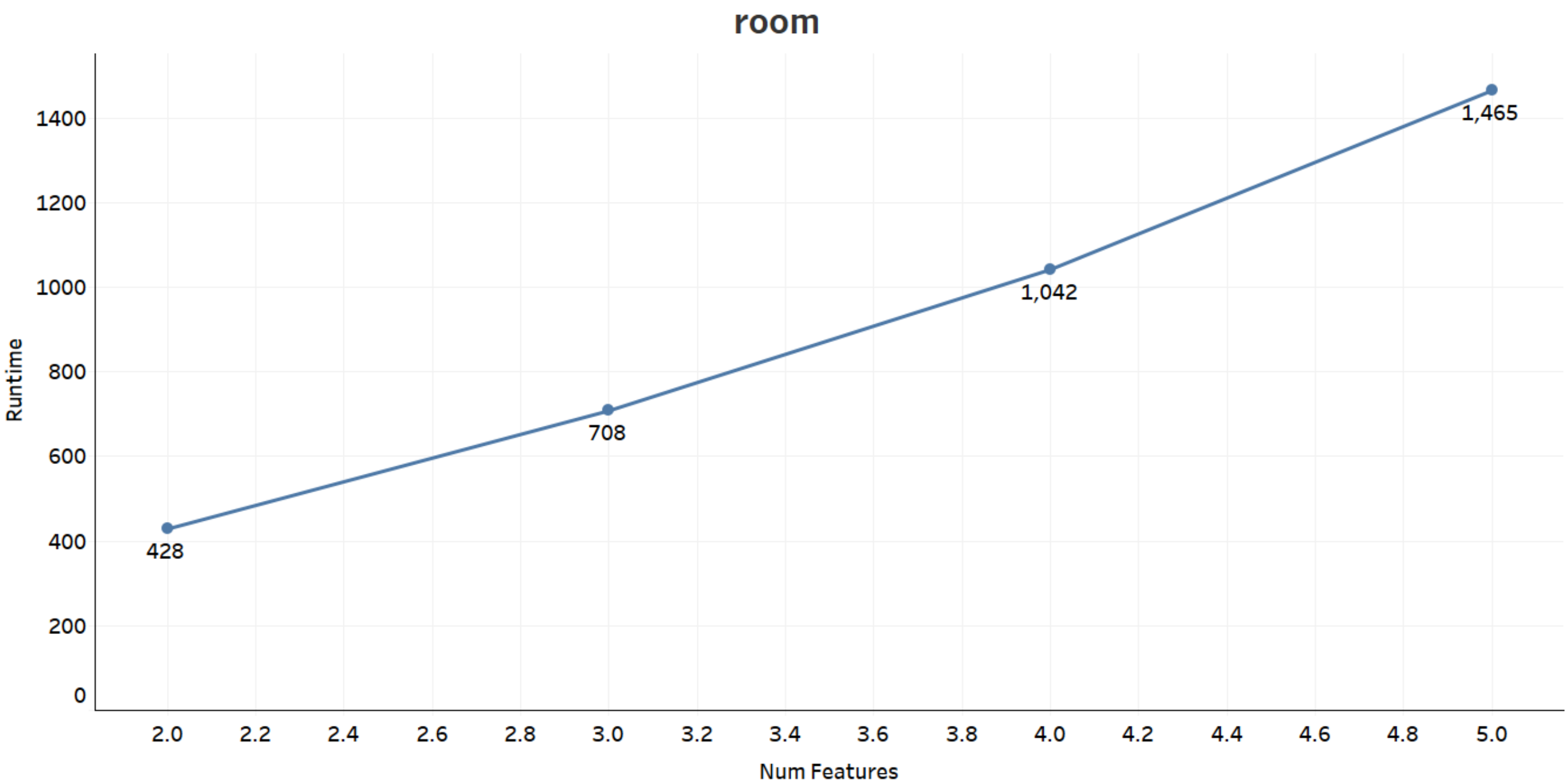
SVC Family - Runtime vs Number of Features

room



VQC - Runtime vs Number of Features

room



VQC - Runtime vs Number of Observations

room