

## NRLMF OUTPUT SUMMARY

Parameters:  $r=20, c=5, K_1=5, \lambda_1=2, \lambda_p=2, \alpha=1, \beta=1, \gamma=0.01, K_2=5$

**CVS-1:** 10-fold cross validation on rows(represents RNAs) in the interaction matrix. The rows were randomly split into 10 equal sets. For each such set:

1. Entries of rows in that set are made 0
2. NRLMF is performed with this set of RNAs as the negative RNA set
3. ROC curve and PR curve are drawn taking the negative RNA set as the test set

[Jump to CVS-1 average results](#)

+++ NRLMF CVS-1: Dataset-0 +++

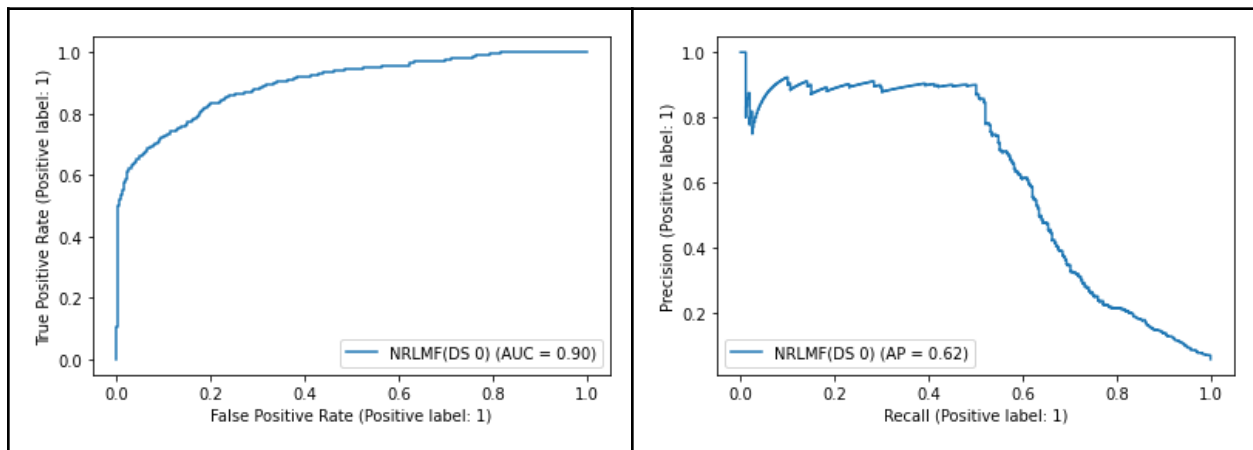
Negative RNA set=

[749, 563, 92, 865, 984, 617, 851, 102, 457, 170, 874, 812, 972, 361, 846, 965, 717, 176, 927, 335, 244, 868, 829, 360, 95, 203, 753, 754, 837, 363, 625, 691, 979, 46, 437, 178, 147, 963, 278, 608, 200, 474, 319, 24, 589, 56, 104, 935, 280, 737, 503, 271, 616, 795, 83, 23, 719, 395, 113, 613, 600, 25, 317, 78, 61, 284, 84, 208, 960, 505, 473, 666, 154, 594, 63, 331, 26, 751, 212, 20, 631, 343, 133, 645, 968, 120, 89, 892, 140, 646, 777, 973, 192, 817, 709, 377, 294, 844, 181]

Iteration count=8368

AUROC=0.9004260994909455

AUPR=0.6218750846006903



NRLMF CVS-1 ROC Curve DS-0

NRLMF CVS-1 PR Curve DS-0

+++ NRLMF CVS-1: Dataset-1 +++

Negative RNA set=

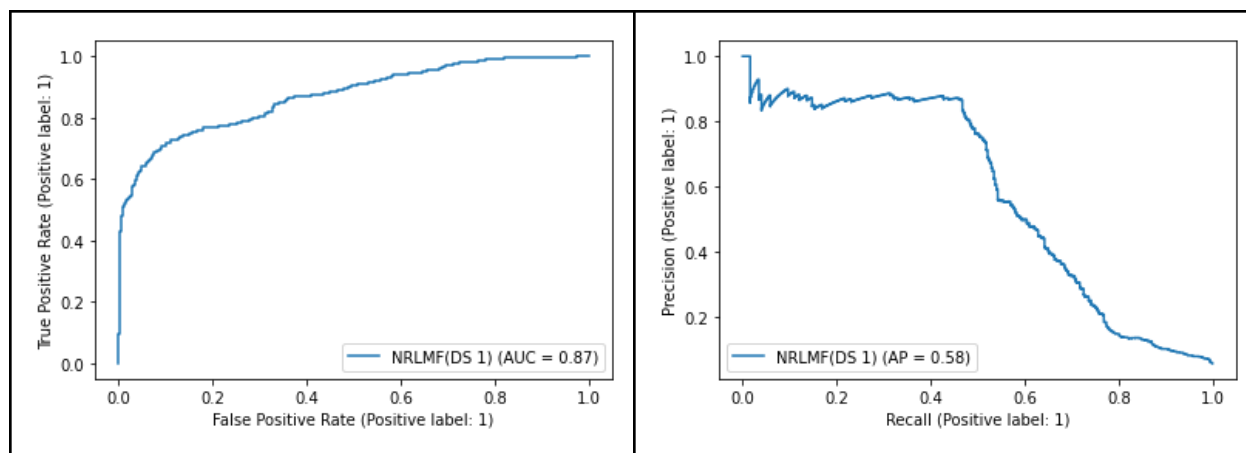
[657, 287, 782, 969, 943, 700, 441, 686, 698, 109, 676, 463, 659, 546, 557, 708, 619, 712, 914, 525, 752, 392, 802, 134, 529, 68, 674, 980, 542, 34, 720, 332, 434, 924, 460, 223, 122, 50, 606, 349, 864, 549, 138, 810,

942, 590, 199, 789, 906, 261, 871, 470, 16, 198, 895, 118, 346, 801, 298, 605, 740, 408, 7, 746, 239, 315, 629, 67, 537, 194, 66, 447, 848, 732, 533, 697, 248, 899, 125, 206, 404, 270, 399, 824, 932, 119, 772, 153, 872, 436, 39, 472, 780, 562, 311, 850, 229, 382, 747]

Iteration count=8953

AUROC=0.8706756669046538

AUPR=0.5817807196128691



NRLMF CVS-1 ROC Curve DS-1

NRLMF CVS-1 PR Curve DS-1

+++ NRLMF CVS-1: Dataset-2 +++

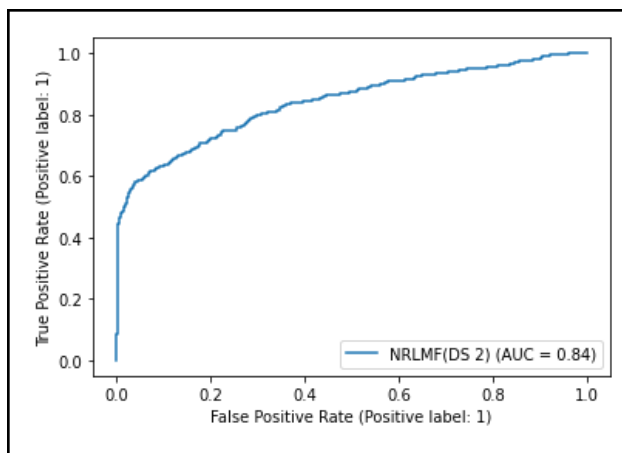
Negative RNA set=

[249, 479, 803, 135, 855, 306, 451, 484, 224, 531, 845, 375, 251, 638, 538, 826, 18, 653, 207, 920, 350, 449, 96, 302, 986, 701, 52, 941, 423, 627, 379, 596, 316, 347, 340, 334, 269, 946, 150, 293, 255, 950, 448, 215, 155, 658, 98, 237, 64, 274, 526, 690, 912, 799, 455, 739, 165, 329, 45, 158, 688, 362, 728, 954, 2, 507, 559, 230, 126, 947, 540, 916, 241, 87, 413, 733, 901, 623, 422, 723, 618, 862, 201, 124, 956, 432, 800, 703, 842, 584, 665, 19, 275, 964, 508, 368, 21, 940, 426]

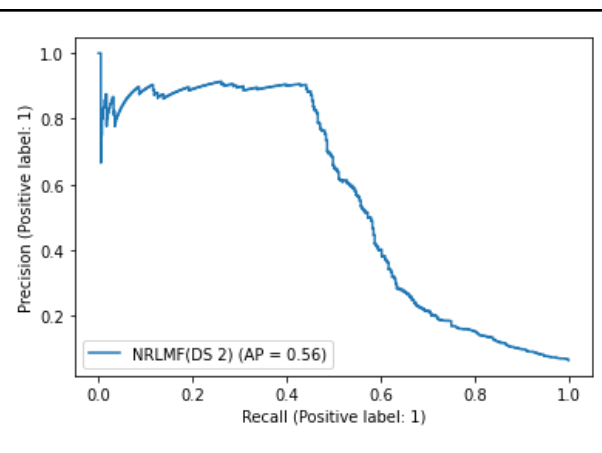
Iteration count=8768

AUROC=0.8407480261692593

AUPR=0.5593224162122352



NRLMF CVS-1 ROC Curve DS-2



NRLMF CVS-1 PR Curve DS-2

+++ NRLMF CVS-1: Dataset-3 +++

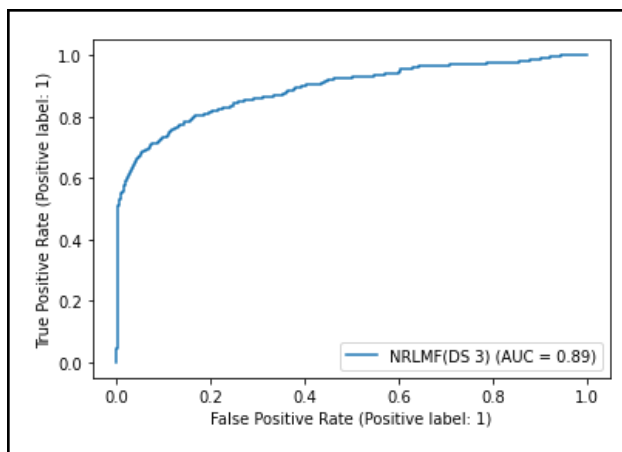
Negative RNA set=

[896, 324, 787, 641, 522, 485, 62, 380, 352, 527, 689, 400, 515, 337, 681, 905, 365, 521, 160, 412, 366, 693, 857, 890, 13, 58, 123, 425, 828, 983, 247, 788, 705, 55, 687, 715, 273, 756, 421, 974, 684, 35, 640, 252, 593, 386, 454, 182, 834, 402, 14, 348, 628, 40, 415, 734, 928, 636, 79, 878, 725, 220, 388, 786, 452, 656, 8, 97, 295, 142, 673, 286, 235, 163, 166, 564, 475, 111, 196, 161, 184, 323, 806, 358, 819, 938, 879, 157, 831, 635, 0, 420, 175, 869, 296, 706, 174, 886, 464]

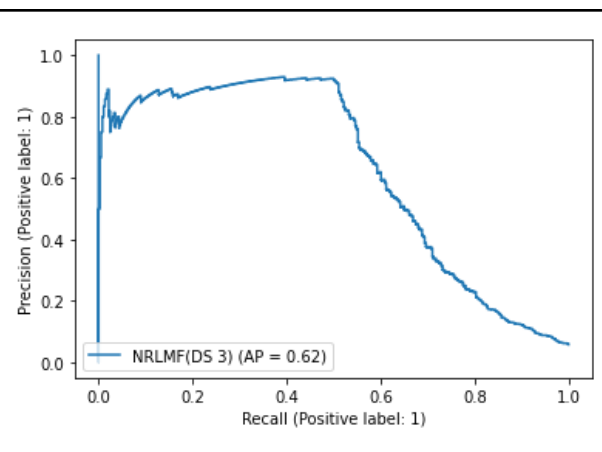
Iteration count=8813

AUROC=0.8899268656579802

AUPR=0.6222670871448832



NRLMF CVS-1 ROC Curve DS-3



NRLMF CVS-1 PR Curve DS-3

+++ NRLMF CVS-1: Dataset-4 +++

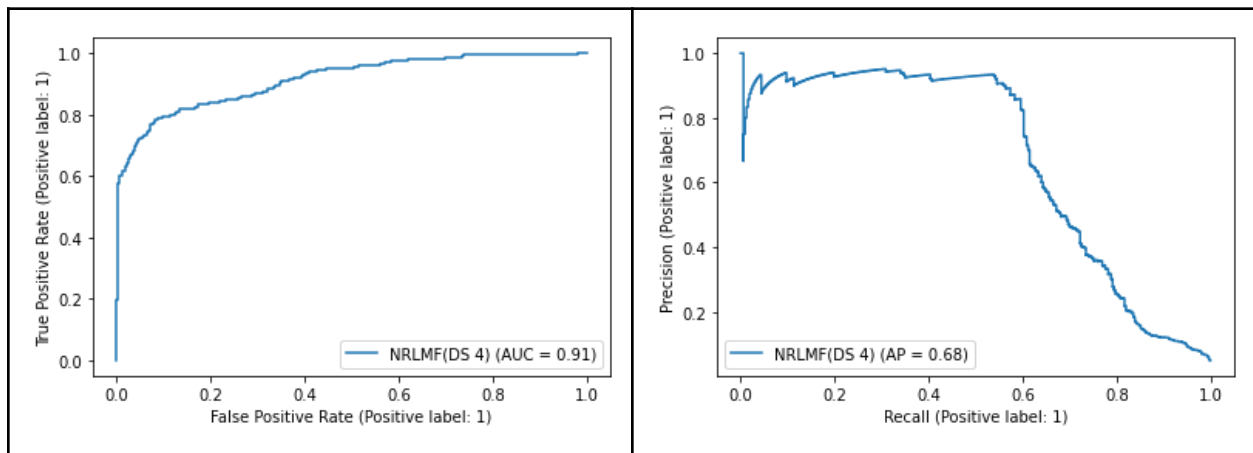
Negative RNA set=

[131, 91, 962, 773, 838, 288, 775, 652, 320, 849, 141, 240, 904, 977, 738, 867, 722, 394, 393, 355, 744, 900, 761, 289, 17, 893, 82, 57, 299, 246, 644, 607, 1, 554, 544, 543, 823, 888, 373, 471, 500, 186, 766, 677, 338, 843, 218, 38, 390, 726, 769, 907, 356, 106, 764, 668, 820, 755, 736, 662, 146, 372, 310, 405, 74, 467, 409, 634, 647, 783, 504, 71, 731, 487, 971, 359, 351, 816, 651, 796, 419, 770, 567, 649, 742, 621, 258, 512, 169, 568, 839, 863, 655, 204, 516, 903, 870, 325, 193]

Iteration count=8816

AUROC=0.9141535505599252

AUPR=0.6763652802909339



NRLMF CVS-1 ROC Curve DS-4

NRLMF CVS-1 PR Curve DS-4

+++ NRLMF CVS-1: Dataset-5 +++

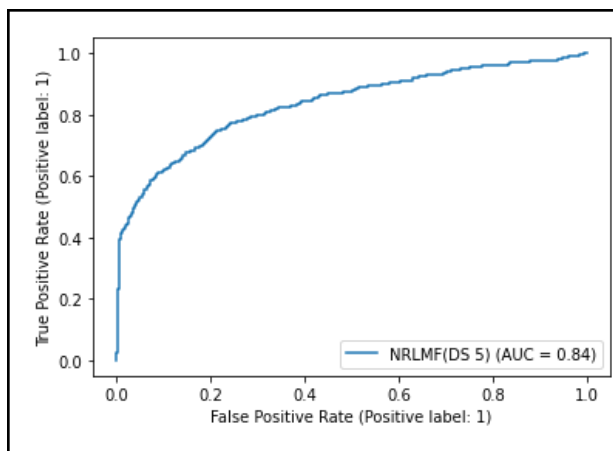
Negative RNA set=

[33, 172, 398, 266, 488, 427, 406, 85, 374, 264, 881, 558, 285, 713, 716, 835, 482, 735, 385, 535, 443, 794, 148, 127, 53, 391, 401, 321, 364, 570, 267, 80, 369, 987, 277, 847, 882, 518, 830, 60, 478, 601, 177, 190, 100, 54, 771, 959, 519, 573, 307, 858, 781, 494, 322, 433, 745, 461, 458, 682, 88, 397, 615, 378, 592, 931, 152, 614, 833, 910, 32, 260, 836, 985, 694, 813, 219, 70, 578, 860, 117, 303, 431, 854, 934, 231, 988, 65, 514, 630, 342, 227, 439, 949, 714, 48, 951, 669, 222]

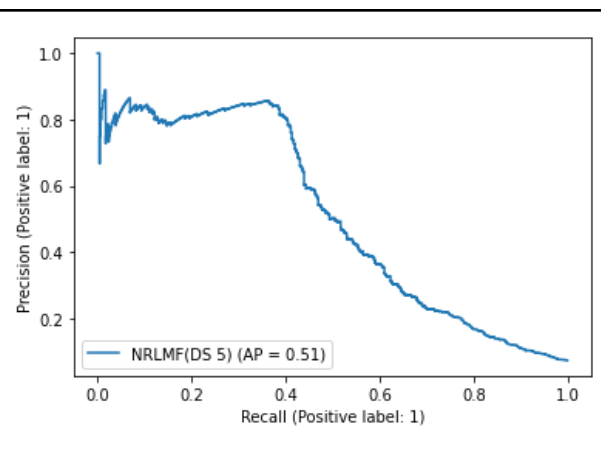
Iteration count=7881

AUROC=0.835060439503749

AUPR=0.5077024341575238



NRLMF CVS-1 ROC Curve DS-5



NRLMF CVS-1 PR Curve DS-5

+++ NRLMF CVS-1: Dataset-6 +++

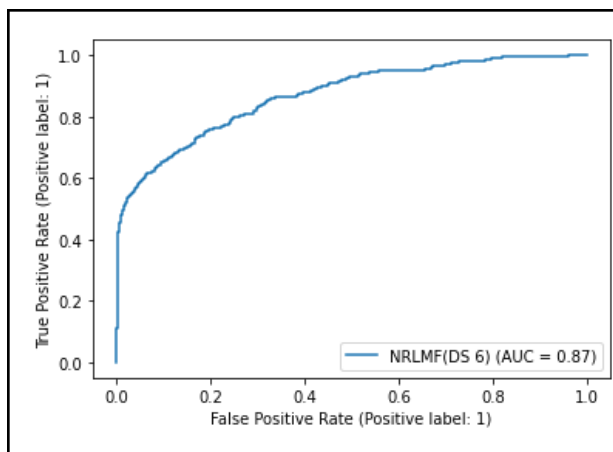
Negative RNA set=

[37, 272, 541, 695, 5, 243, 603, 588, 29, 480, 502, 236, 925, 692, 528, 561, 670, 923, 620, 661, 982, 637, 105, 371, 51, 591, 195, 36, 103, 94, 156, 915, 4, 15, 595, 12, 115, 632, 609, 536, 28, 159, 822, 654, 489, 462, 179, 534, 101, 202, 493, 952, 213, 776, 599, 809, 137, 582, 44, 90, 276, 922, 210, 297, 575, 957, 442, 417, 743, 491, 414, 767, 232, 532, 3, 970, 911, 265, 579, 553, 586, 908, 476, 624, 216, 547, 933, 86, 407, 77, 889, 31, 145, 290, 10, 304, 330, 727, 918]

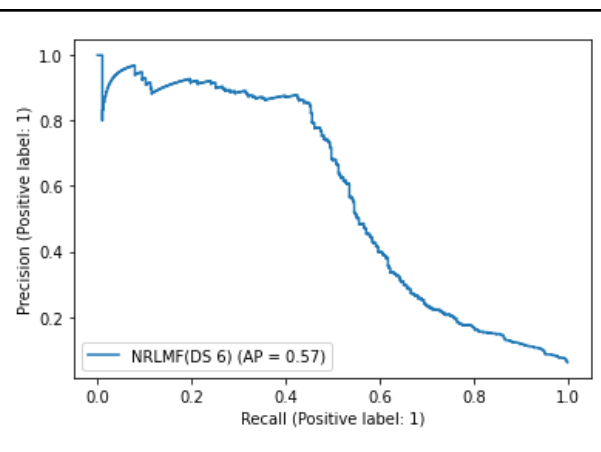
Iteration count=9758

AUROC=0.869511500944397

AUPR=0.5737601746568197



NRLMF CVS-1 ROC Curve DS-6



NRLMF CVS-1 PR Curve DS-6

+++ NRLMF CVS-1: Dataset-7 +++

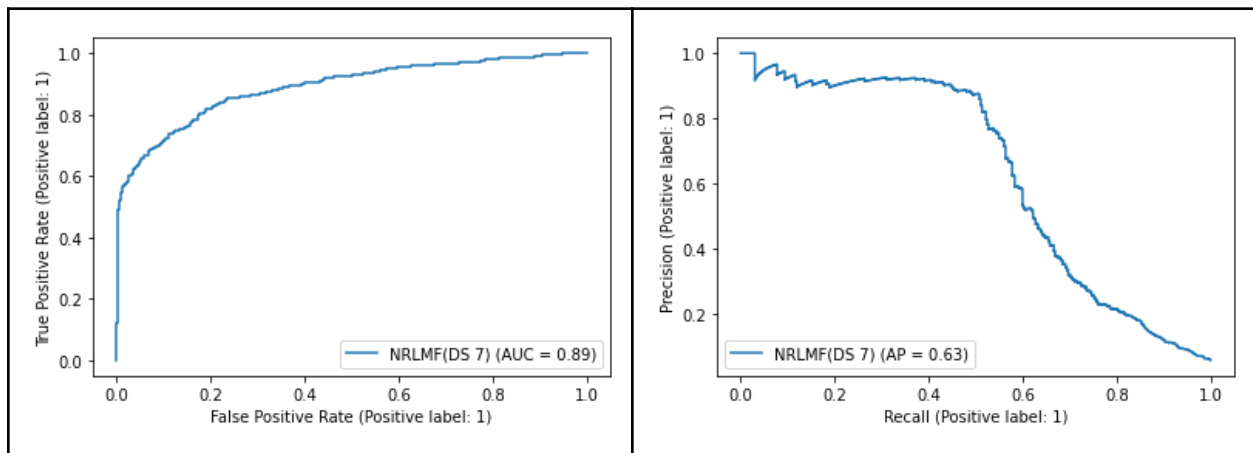
Negative RNA set=

[944, 357, 937, 587, 696, 976, 748, 818, 233, 576, 456, 711, 883, 571, 435, 866, 897, 683, 707, 309, 778, 877, 939, 424, 539, 729, 41, 171, 410, 750, 966, 30, 611, 917, 779, 859, 501, 180, 465, 887, 814, 583, 209, 387, 116, 353, 253, 757, 660, 47, 411, 185, 730, 981, 42, 466, 495, 73, 183, 560, 566, 281, 913, 197, 191, 381, 327, 667, 762, 704, 136, 496, 469, 572, 217, 785, 792, 167, 506, 164, 498, 523, 825, 492, 162, 99, 250, 604, 279, 256, 861, 675, 626, 768, 282, 784, 875, 314, 648]

Iteration count=8512

AUROC=0.8901378662799345

AUPR=0.6286433245782772



NRLMF CVS-1 ROC Curve DS-7

NRLMF CVS-1 PR Curve DS-7

+++ NRLMF CVS-1: Dataset-8 +++

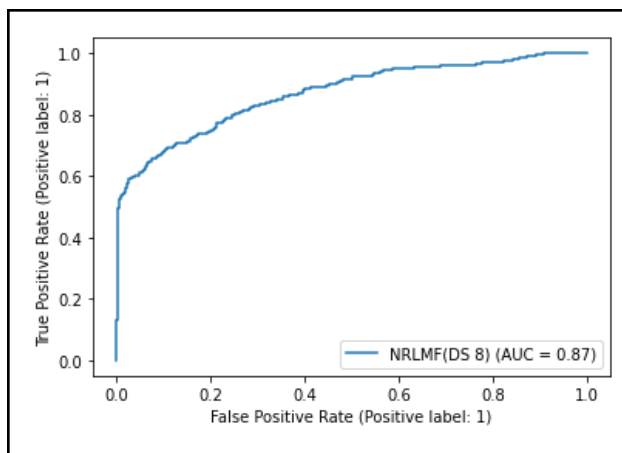
Negative RNA set=

[565, 389, 459, 76, 702, 345, 483, 791, 468, 517, 430, 312, 967, 187, 545, 774, 815, 110, 612, 93, 827, 760, 989, 149, 685, 59, 238, 22, 909, 509, 679, 168, 450, 680, 81, 214, 305, 808, 328, 840, 758, 948, 341, 11, 556, 832, 664, 173, 370, 978, 144, 221, 797, 902, 225, 577, 598, 804, 132, 114, 953, 936, 876, 43, 574, 958, 724, 121, 72, 975, 643, 139, 339, 234, 880, 27, 383, 569, 926, 699, 128, 530, 805, 663, 268, 318, 548, 497, 633, 884, 445, 440, 75, 602, 580, 301, 283, 650, 444]

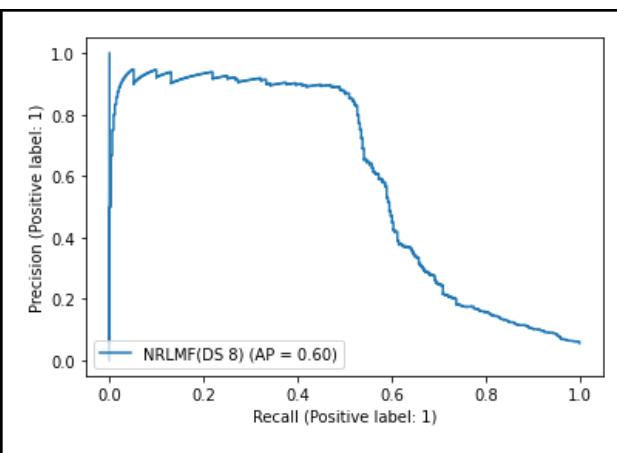
Iteration count=8195

AUROC=0.8695885011674486

AUPR=0.5959787580550565



NRLMF CVS-1 ROC Curve DS-8



NRLMF CVS-1 PR Curve DS-8

+++ NRLMF CVS-1: Dataset-9 +++

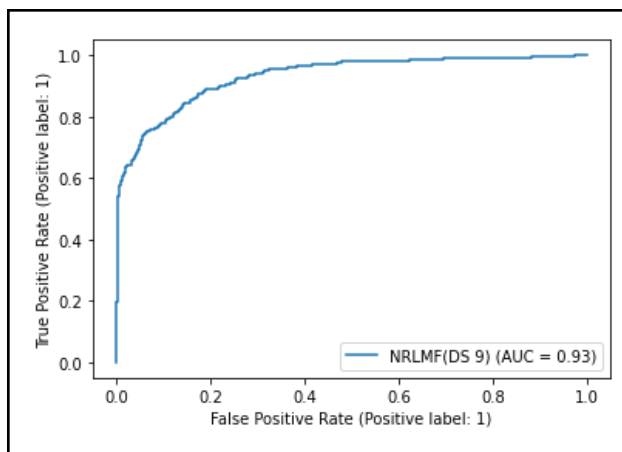
Negative RNA set=

[112, 403, 807, 107, 873, 69, 585, 763, 520, 721, 396, 513, 262, 151, 354, 130, 891, 428, 259, 853, 929, 242, 511, 300, 945, 597, 486, 718, 376, 313, 292, 551, 333, 741, 921, 344, 919, 671, 254, 821, 856, 245, 639, 188, 898, 291, 108, 129, 257, 429, 550, 211, 765, 49, 189, 524, 581, 790, 552, 793, 798, 384, 642, 885, 678, 555, 453, 336, 955, 308, 961, 367, 759, 228, 418, 481, 930, 894, 9, 438, 841, 226, 852, 811, 710, 610, 477, 416, 672, 326, 263, 446, 499, 143, 205, 6, 510, 490, 622]

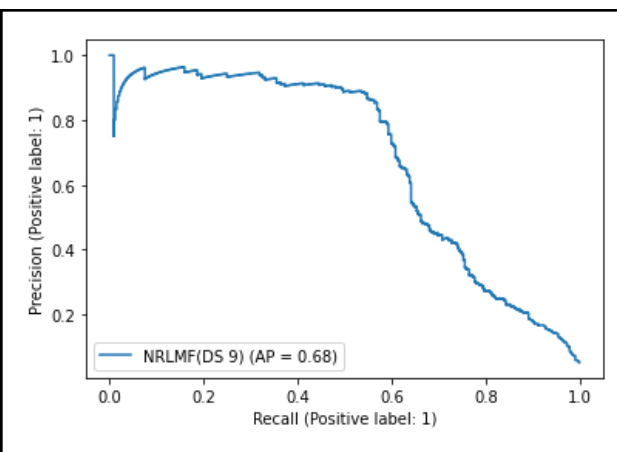
Iteration count=9228

AUROC=0.9315837634348186

AUPR=0.6800650800432312



NRLMF CVS-1 ROC Curve DS-9

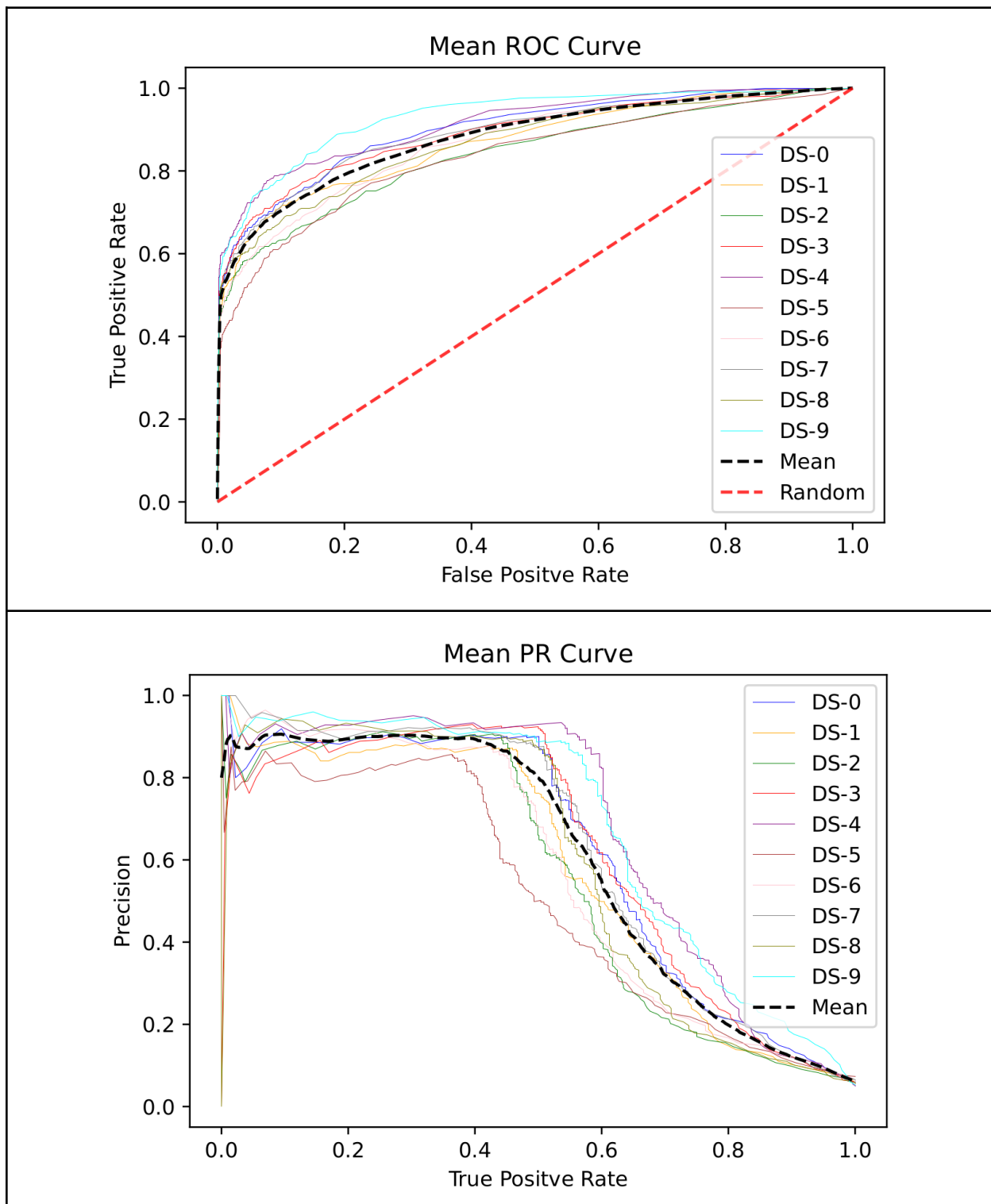


NRLMF CVS-1 PR Curve DS-9

AVERAGE RESULTS CVS-1:

AUROC (arithmetic mean) = **0.881181228**

AUPR (arithmetic mean) = **0.604776036**





**CVS-2:** 16-fold cross validation on columns(represents Proteins) in the interaction matrix. The columns were randomly split into 16 equal sets(took 16 for ease of division since the total number of proteins taken is 64). For each such set:

1. Entries of columns in that set are made 0
2. NRLMF is performed with this set of proteins as the negative protein set
3. ROC curve and PR curve are drawn taking the negative protein set as the test set

[Jump to CVS-2 average results](#)

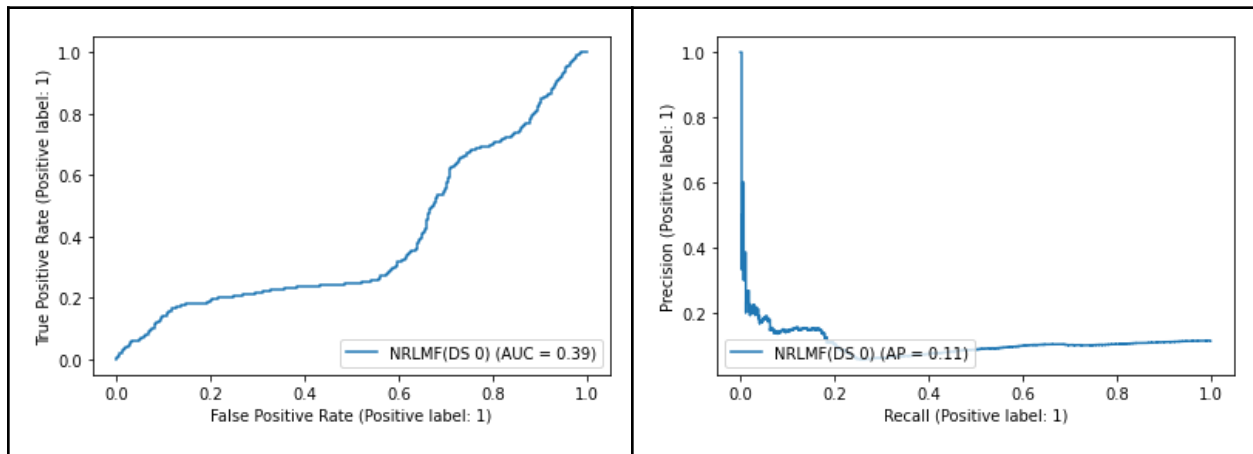
+++ NRLMF CVS-2: Dataset-0 +++

Negative protein set= [34, 6, 13, 54]

Iteration count=7578

AUROC=0.3943744560515146

AUPR=0.10879344184776682



NRLMF CVS-2 ROC Curve DS-0

NRLMF CVS-2 PR Curve DS-0

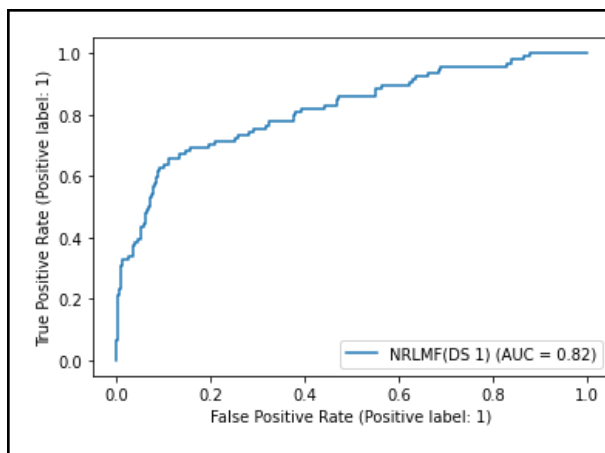
+++ NRLMF CVS-2: Dataset-1 +++

Negative protein set= [16, 31, 46, 53]

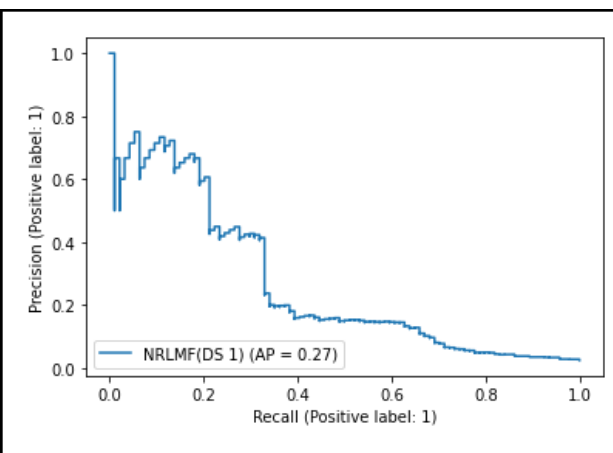
Iteration count=8733

AUROC=0.8174043213613499

AUPR=0.26656696269352

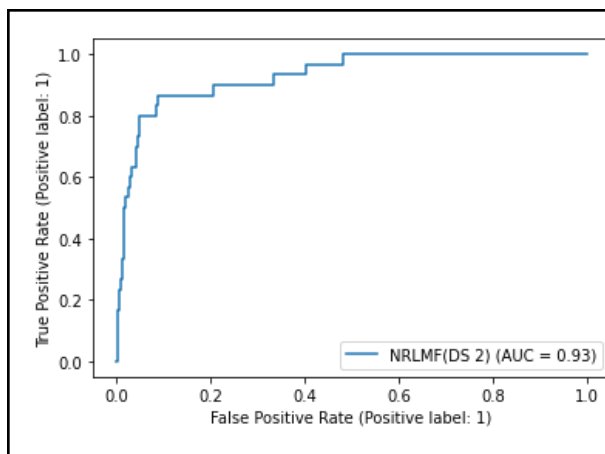


NRLMF CVS-2 ROC Curve DS-1

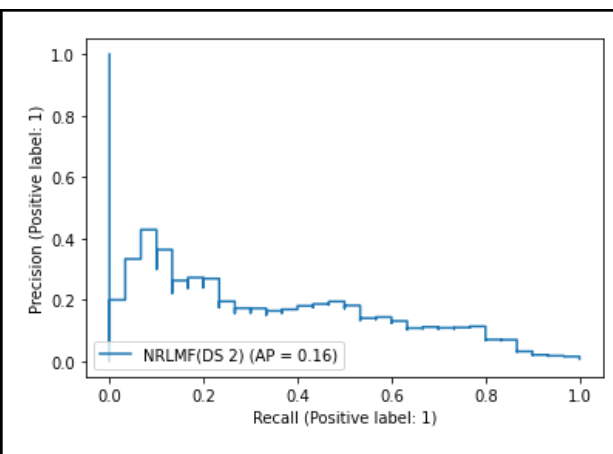


NRLMF CVS-2 PR Curve DS-1

```
+++ NRLMF CVS-2: Dataset-2 +++
Negative protein set= [21, 38, 60, 33]
Iteration count=7700
AUROC=0.9317217981340118
AUPR=0.16480753187311284
```

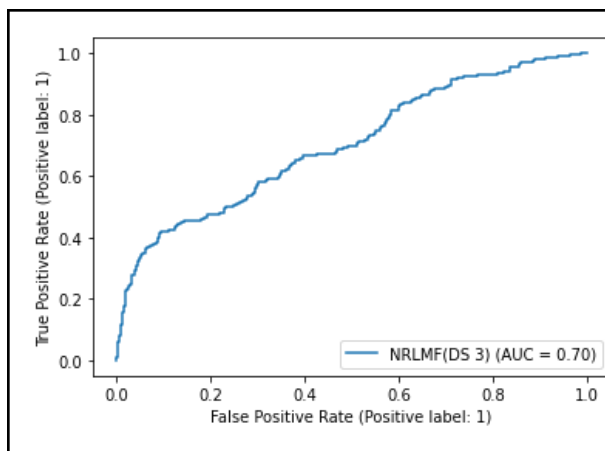


NRLMF CVS-2 ROC Curve DS-2

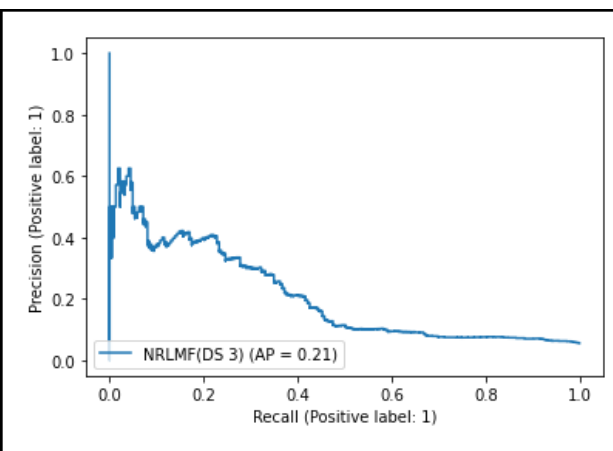


NRLMF CVS-2 PR Curve DS-2

```
+++ NRLMF CVS-2: Dataset-3 +++
Negative protein set= [2, 14, 26, 35]
Iteration count=8325
AUROC=0.7017439230288318
AUPR=0.20710966103647782
```

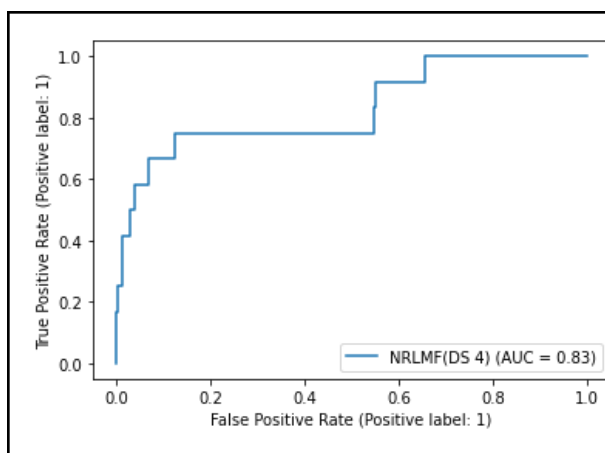


NRLMF CVS-2 ROC Curve DS-3

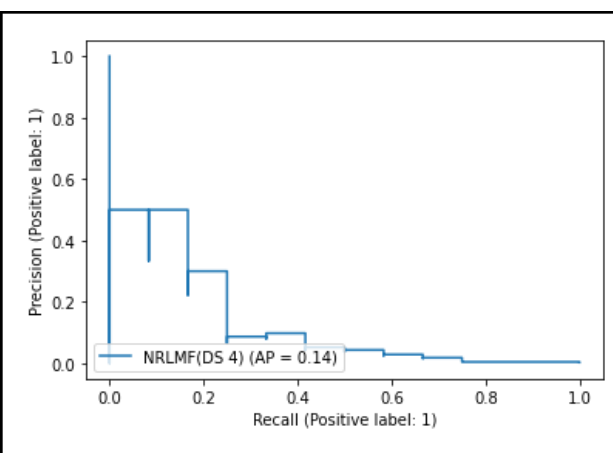


NRLMF CVS-2 PR Curve DS-3

+++ NRLMF CVS-2: Dataset-4 +++  
 Negative protein set= [59, 52, 42, 63]  
 Iteration count=8951  
 AUROC=0.8302727119216481  
 AUPR=0.13681626592720655

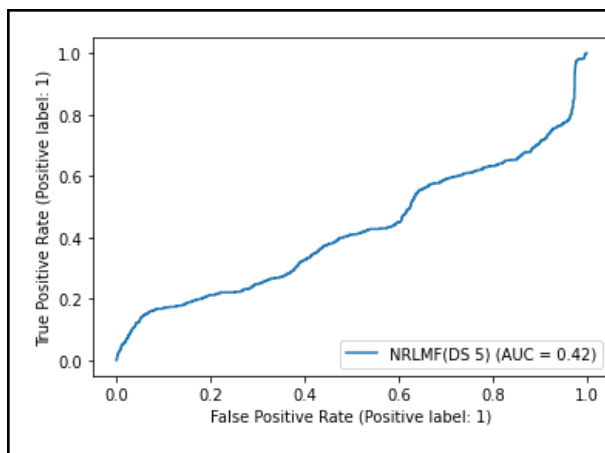


NRLMF CVS-2 ROC Curve DS-4

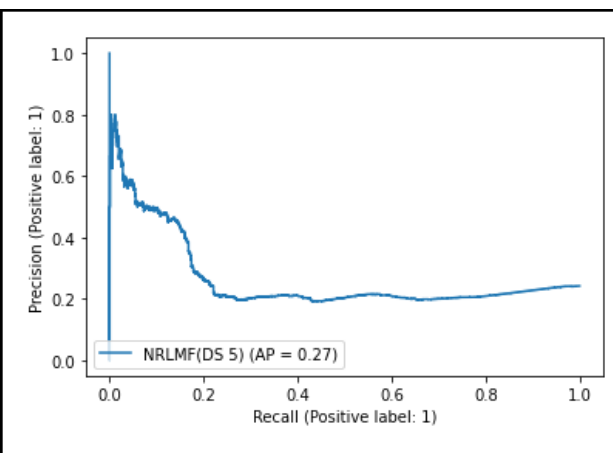


NRLMF CVS-2 PR Curve DS-4

+++ NRLMF CVS-2: Dataset-5 +++  
 Negative protein set= [7, 4, 32, 22]  
 Iteration count=7884  
 AUROC=0.42377532133015106  
 AUPR=0.26794040406973596

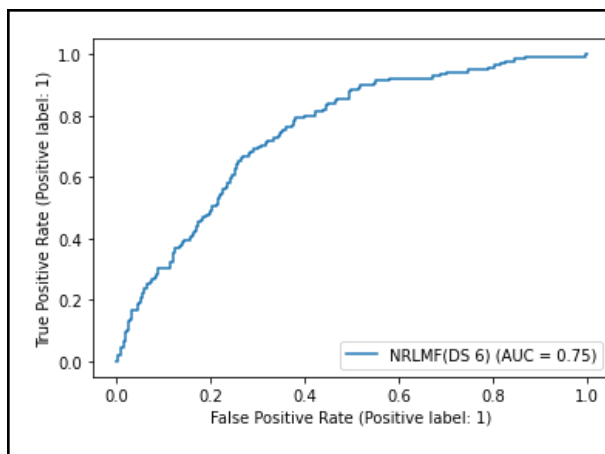


NRLMF CVS-2 ROC Curve DS-5

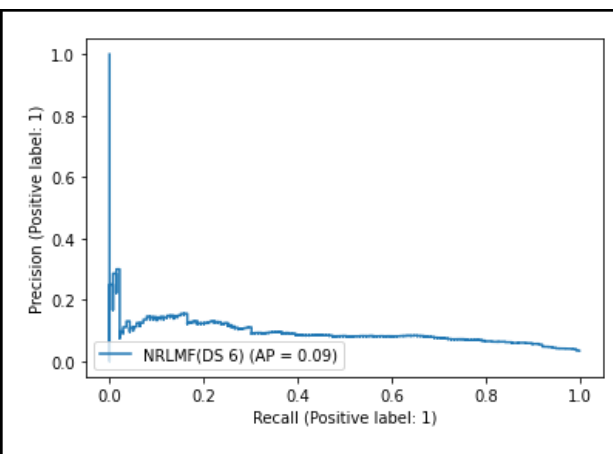


NRLMF CVS-2 PR Curve DS-5

+++ NRLMF CVS-2: Dataset-6 +++  
 Negative protein set= [10, 39, 44, 43]  
 Iteration count=8588  
 AUROC=0.751008719326554  
 AUPR=0.09382022010958256

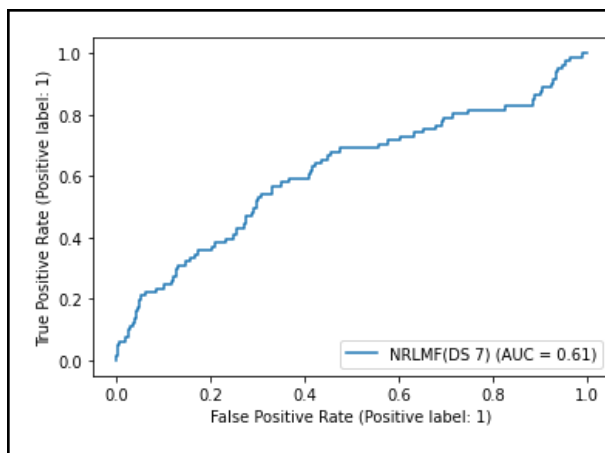


NRLMF CVS-2 ROC Curve DS-6

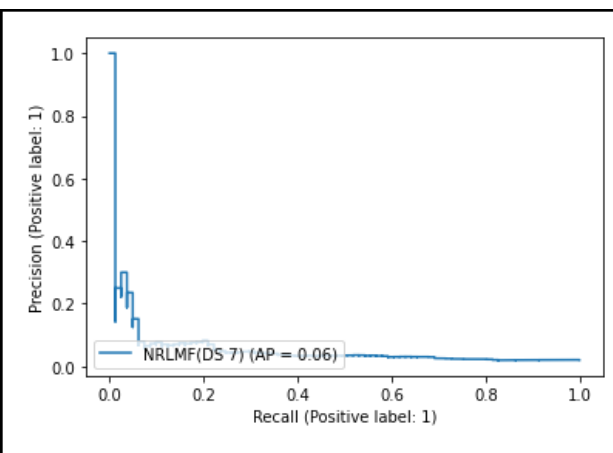


NRLMF CVS-2 PR Curve DS-6

+++ NRLMF CVS-2: Dataset-7 +++  
 Negative protein set= [25, 36, 12, 48]  
 Iteration count=10030  
 AUROC=0.6146168511039183  
 AUPR=0.05954327975473403

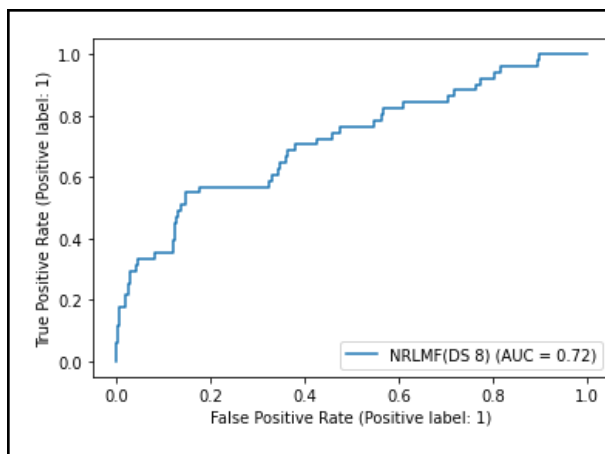


NRLMF CVS-2 ROC Curve DS-7

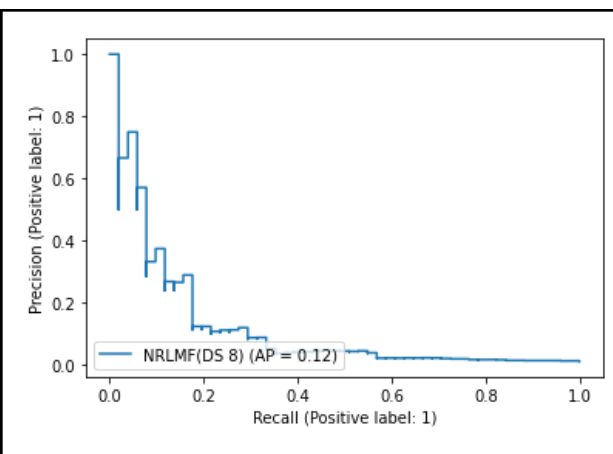


NRLMF CVS-2 PR Curve DS-7

+++ NRLMF CVS-2: Dataset-8 +++  
 Negative protein set= [62, 29, 27, 20]  
 Iteration count=8409  
 AUROC=0.7198119974518331  
 AUPR=0.12477641577042871

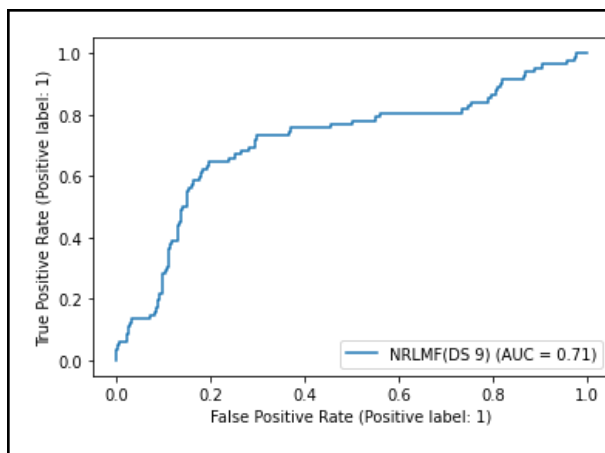


NRLMF CVS-2 ROC Curve DS-8

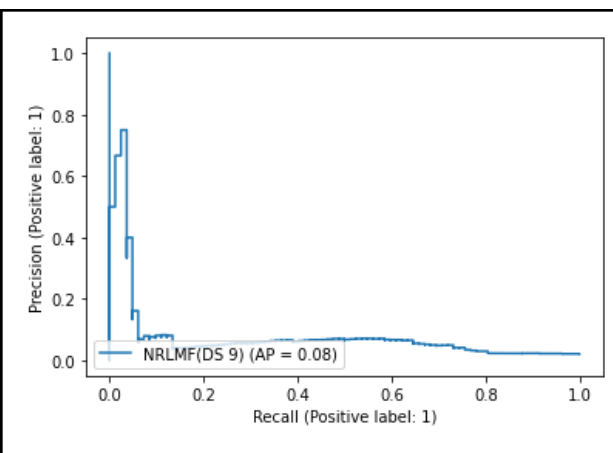


NRLMF CVS-2 PR Curve DS-8

+++ NRLMF CVS-2: Dataset-9 +++  
 Negative protein set= [3, 50, 5, 41]  
 Iteration count=8119  
 AUROC=0.7108642876011018  
 AUPR=0.07808162303819033

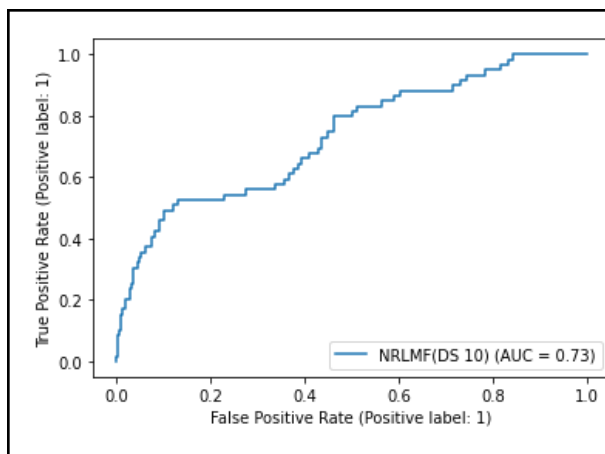


NRLMF CVS-2 ROC Curve DS-9

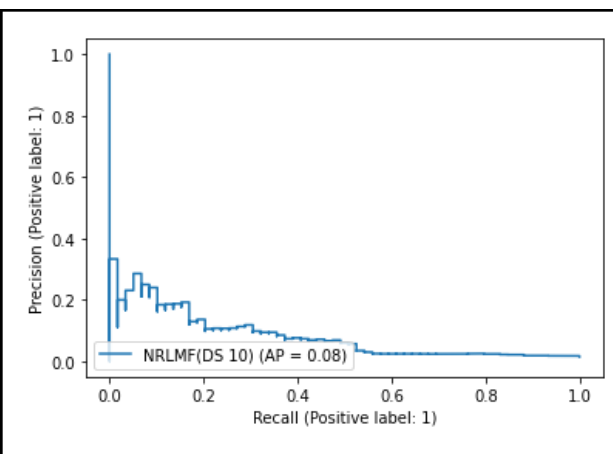


NRLMF CVS-2 PR Curve DS-9

```
+++ NRLMF CVS-2: Dataset-10 +++
Negative protein set= [45, 61, 11, 47]
Iteration count=8768
AUROC=0.7310815566630026
AUPR=0.08226797163617039
```

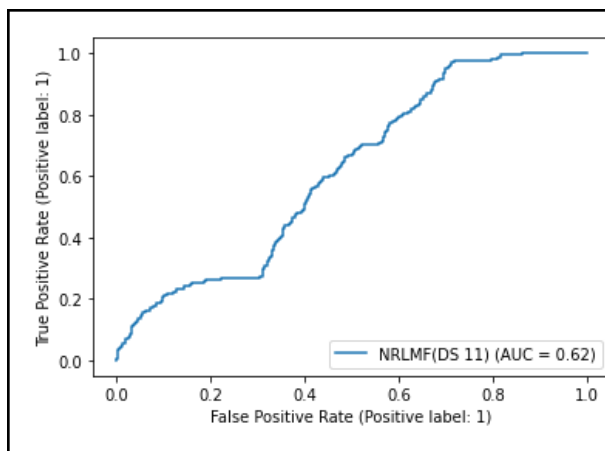


NRLMF CVS-2 ROC Curve DS-10

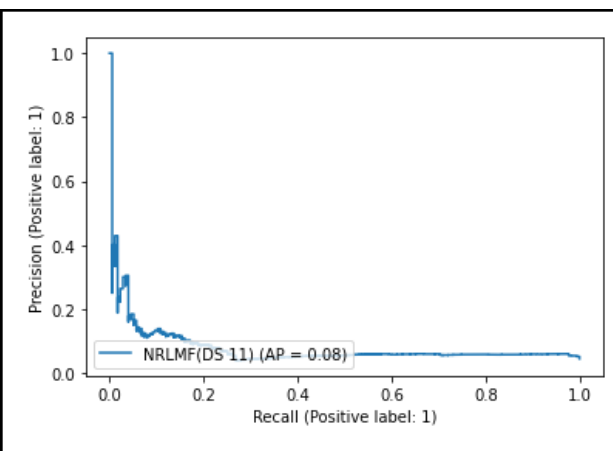


NRLMF CVS-2 PR Curve DS-10

```
+++ NRLMF CVS-2: Dataset-11 +++
Negative protein set= [24, 40, 28, 17]
Iteration count=9406
AUROC=0.6166718248726174
AUPR=0.08126634546875909
```

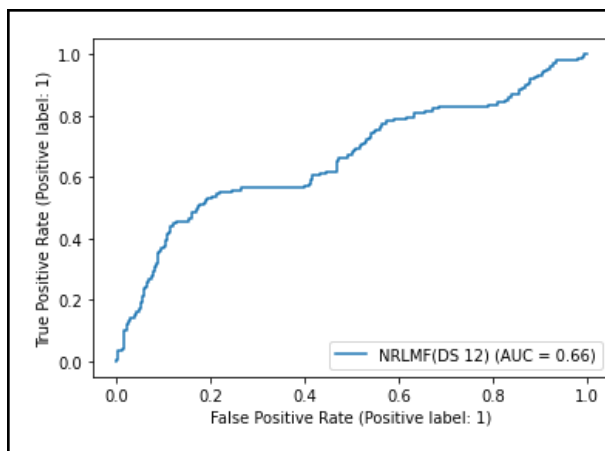


NRLMF CVS-2 ROC Curve DS-11

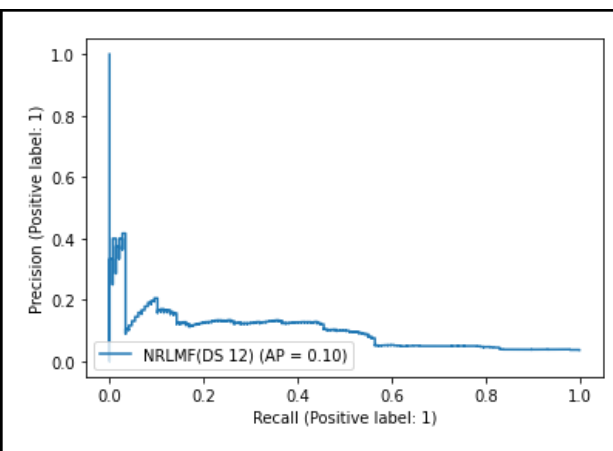


NRLMF CVS-2 PR Curve DS-11

```
+++ NRLMF CVS-2: Dataset-12 +++
Negative protein set= [8, 0, 19, 49]
Iteration count=8657
AUROC=0.6635623564925577
AUPR=0.10060344552373236
```

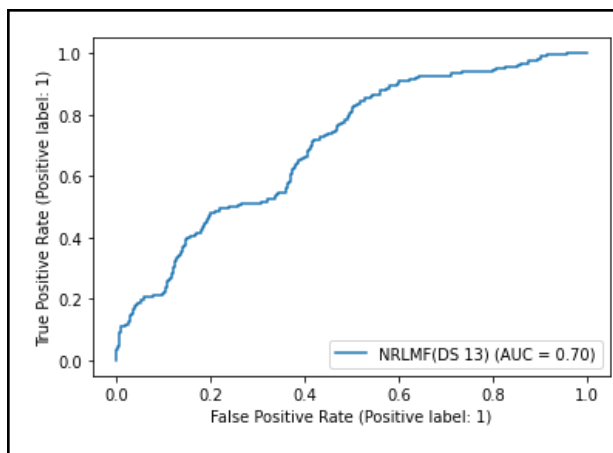


NRLMF CVS-2 ROC Curve DS-12

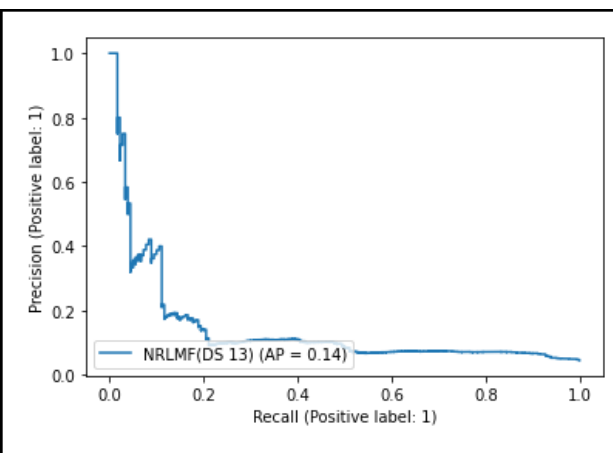


NRLMF CVS-2 PR Curve DS-12

```
+++ NRLMF CVS-2: Dataset-13 +++
Negative protein set= [18, 9, 23, 55]
Iteration count=8059
AUROC=0.7017151675485009
AUPR=0.14251797500795346
```



NRLMF CVS-2 ROC Curve DS-13



NRLMF CVS-2 PR Curve DS-13

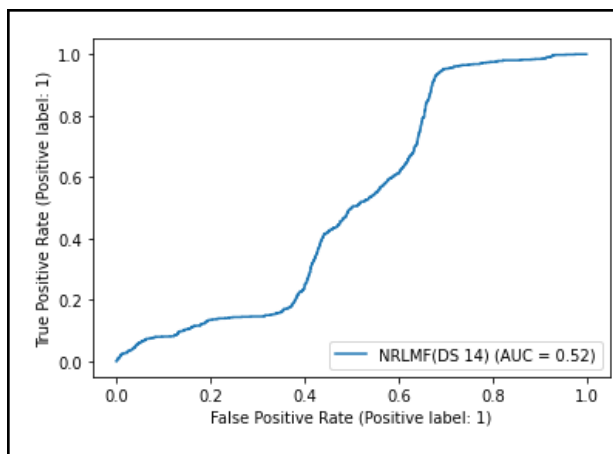
+++ NRLMF CVS-2: Dataset-14 +++

Negative protein set= [51, 1, 57, 15]

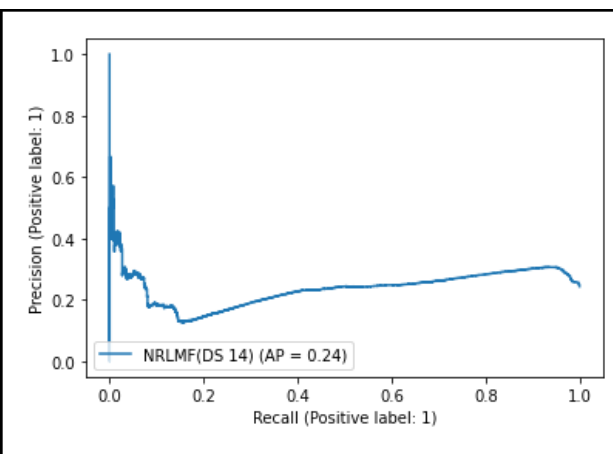
Iteration count=8568

AUROC=0.5151410481418324

AUPR=0.2428367232560794



NRLMF CVS-2 ROC Curve DS-14



NRLMF CVS-2 PR Curve DS-14

+++ NRLMF CVS-2: Dataset-15 +++

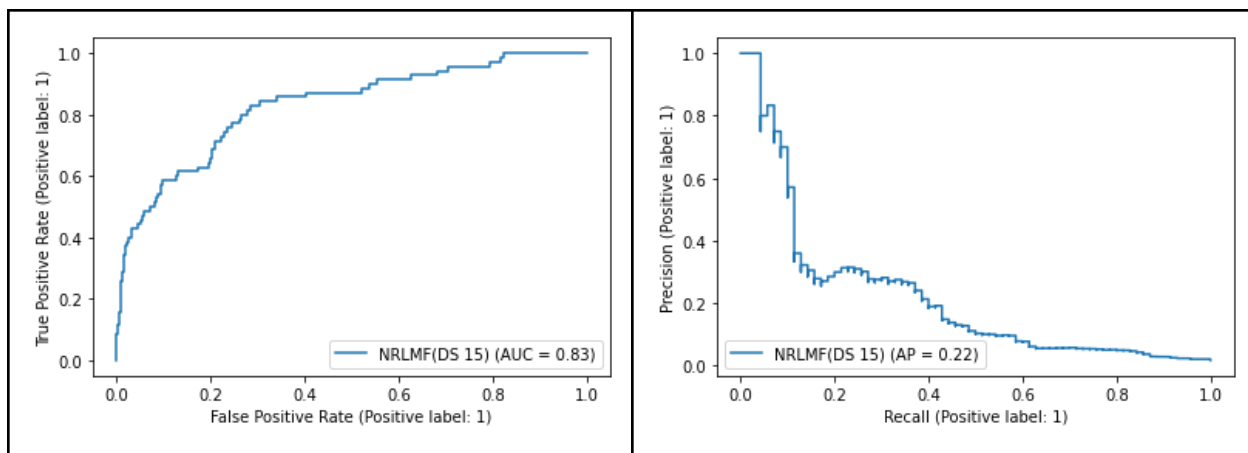
Negative protein set= [30, 56, 58, 37]

Iteration count=8084

AUROC=0.8295886889460155

AUPR=0.21944047195088892





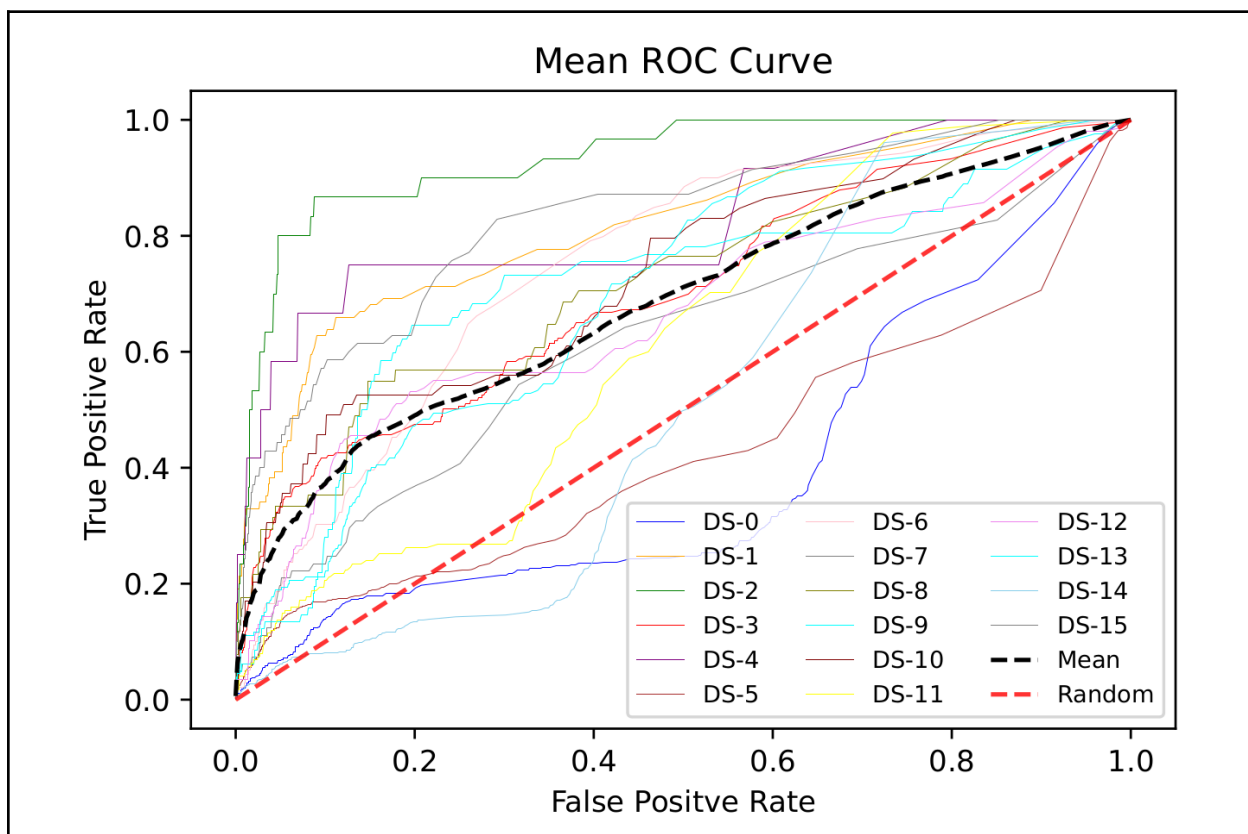
NRLMF CVS-2 ROC Curve DS-15

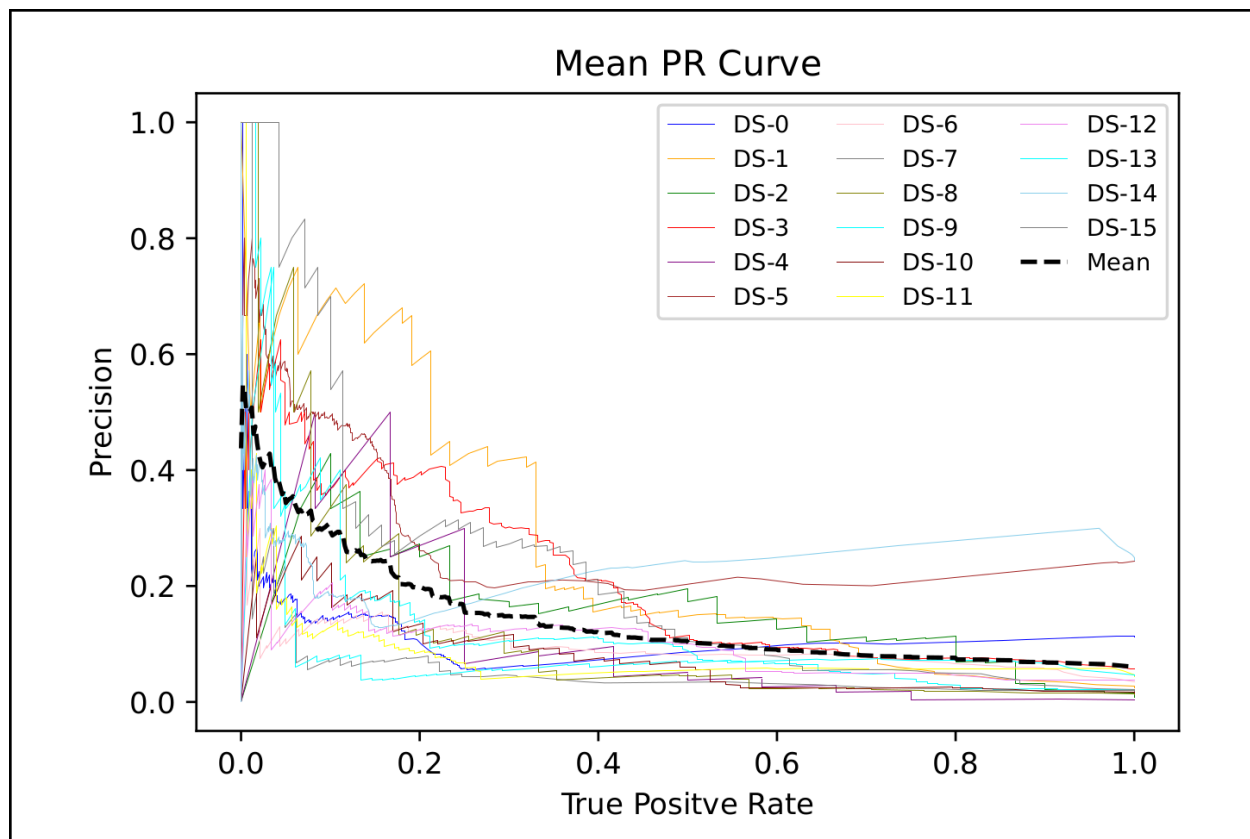
NRLMF CVS-2 PR Curve DS-15

#### AVERAGE RESULTS CVS-2:

AUROC (arithmetic mean) = **0.684584689373465**

AUPR (arithmetic mean) = **0.1485742961852712**



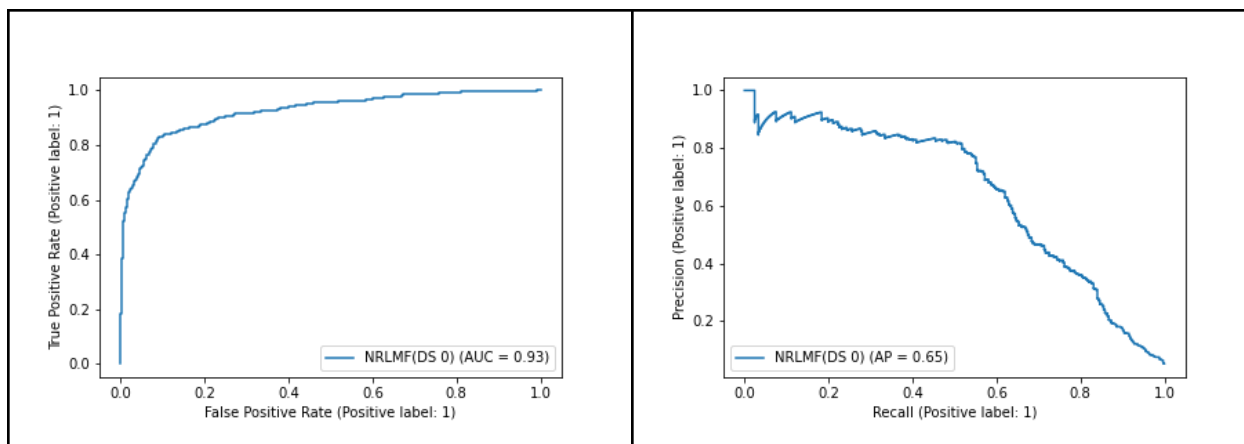


**CVS-3:** 10-fold cross validation on the entries of the interaction matrix. The entries of the interaction matrix are randomly split into 10 equal sets (10 disjoint sets of ordered pairs  $(i,j)$ ,  $1 \leq i \leq \text{rna\_cnt}$  &  $1 \leq j \leq \text{prot\_cnt}$ ). For each such set:

1. The corresponding entries are made 0 (some of them were already 0 so they need not be changed).
2. Due to the previous step, some rows and columns might become all 0, such rows(RNAs) and columns(proteins) are added to the `neg_rna_set` and `neg_prot_set` respectively
3. NRLMF is performed
4. ROC curve and PR curve are drawn taking the zeroed out entries as the test set.

[Jump to CVS-3 average results](#)

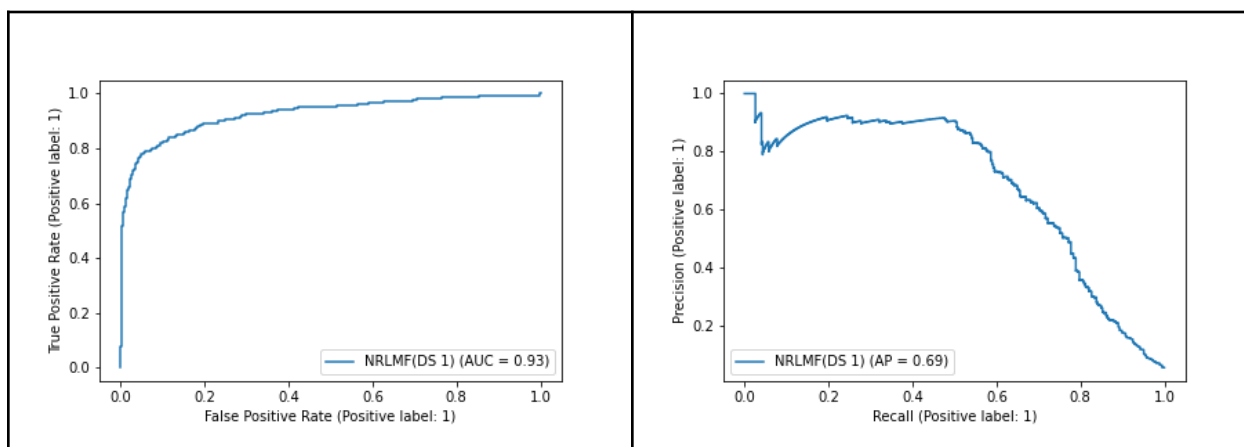
```
+++ NRLMF CVS-3: Dataset-0 +++
Negative RNA set= [181, 340, 763]
Negative protein set= []
Iteration count=11111
AUROC=0.9250339131342157
AUPR=0.6465063249335875
```



NRLMF CVS-3 ROC Curve DS-0

NRLMF CVS-3 PR Curve DS-0

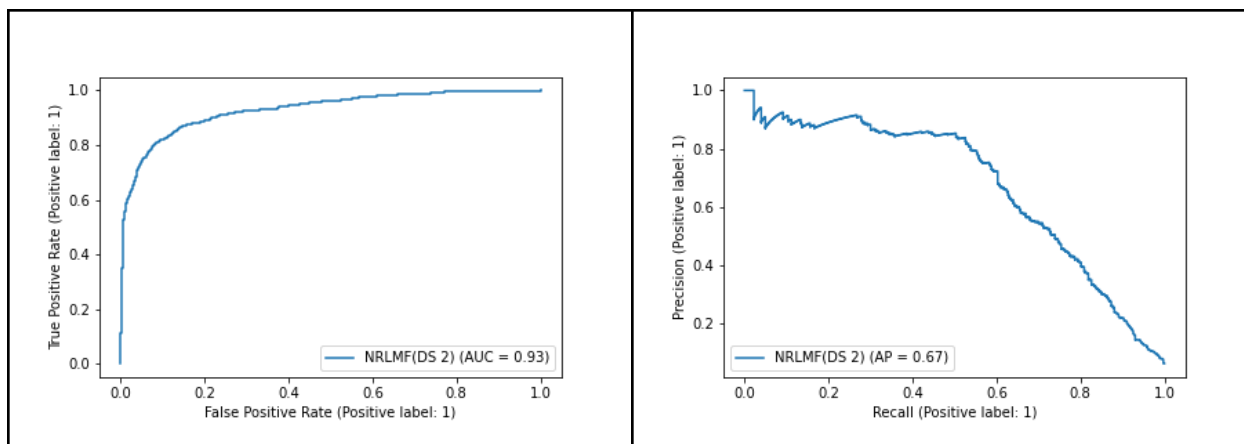
```
+++ NRLMF CVS-3: Dataset-1 +++
Negative RNA set= [79, 281, 724, 793]
Negative protein set= []
Iteration count=9652
AUROC=0.9264390554585193
AUPR=0.6897265923165335
```



NRLMF CVS-3 ROC Curve DS-1

NRLMF CVS-3 PR Curve DS-1

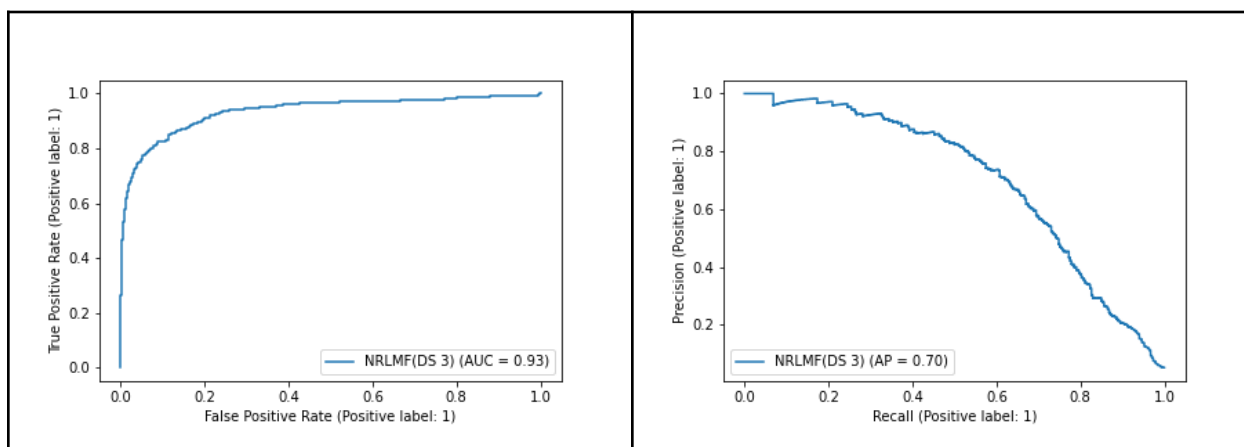
```
+++ NRLMF CVS-3: Dataset-2 +++
Negative RNA set= [38, 208, 618, 624, 722]
Negative protein set= []
Iteration count=11496
AUROC=0.9289209238481488
AUPR=0.6741851370037678
```



NRLMF CVS-3 ROC Curve DS-2

NRLMF CVS-3 PR Curve DS-2

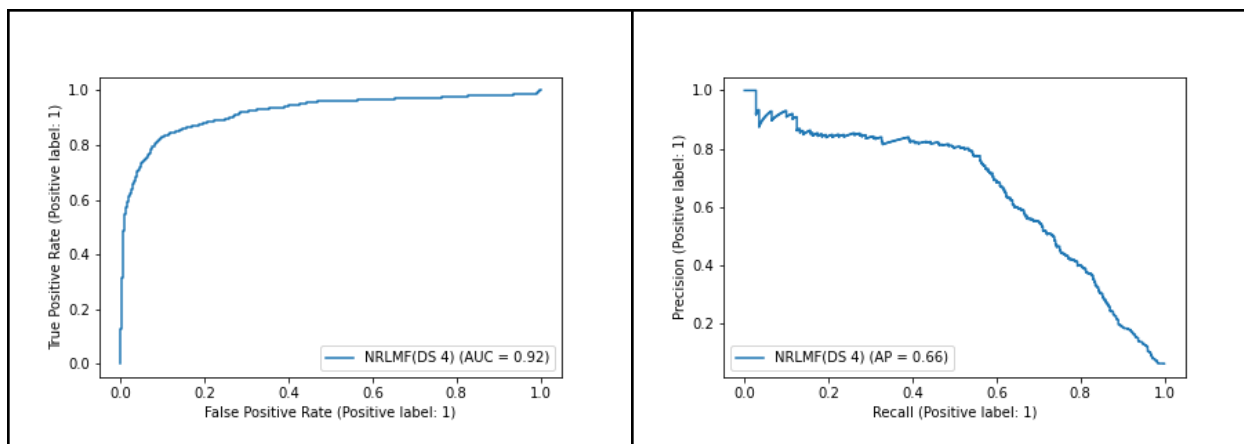
```
+++ NRLMF CVS-3: Dataset-3 +++
Negative RNA set= [61, 284, 318, 602]
Negative protein set= [49, 56]
Iteration count=11303
AUROC=0.9344699471433674
AUPR=0.7012684444506063
```



NRLMF CVS-3 ROC Curve DS-3

NRLMF CVS-3 PR Curve DS-3

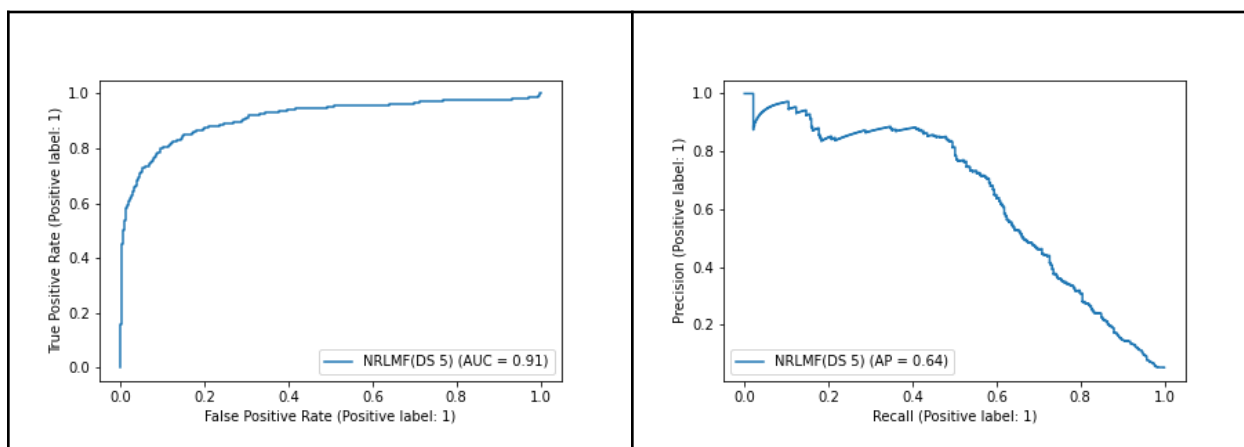
```
+++ NRLMF CVS-3: Dataset-4 +++
Negative RNA set= [91, 668, 781, 809, 842]
Negative protein set= []
Iteration count=12755
AUROC=0.9201100030042837
AUPR=0.6567263877320624
```



NRLMF CVS-3 ROC Curve DS-4

NRLMF CVS-3 PR Curve DS-4

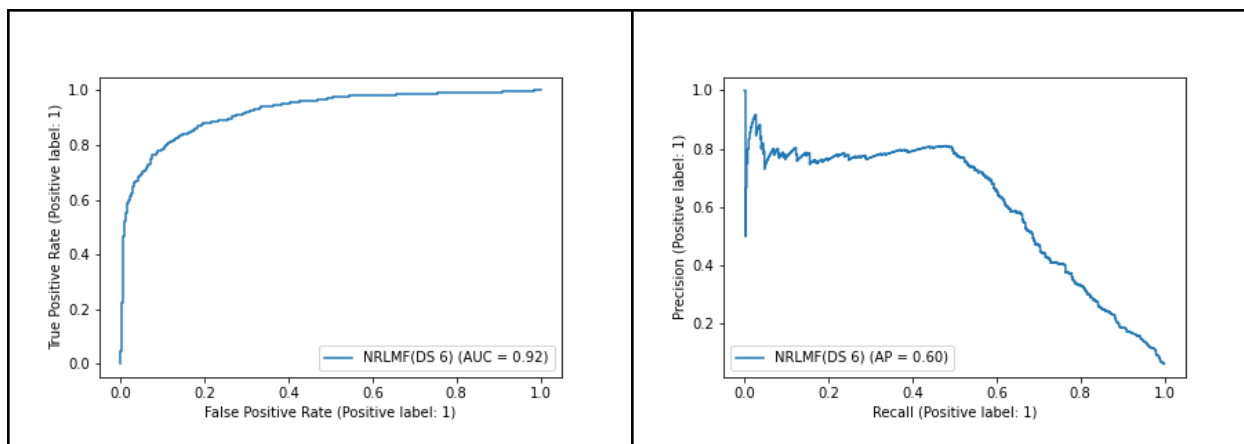
+++ NRLMF CVS-3: Dataset-5 +++  
 Negative RNA set= [450, 688, 875, 934]  
 Negative protein set= [47, 60]  
 Iteration count=11582  
 AUROC=0.9128028578303442  
 AUPR=0.6422450802246543



NRLMF CVS-3 ROC Curve DS-5

NRLMF CVS-3 PR Curve DS-5

+++ NRLMF CVS-3: Dataset-6 +++  
 Negative RNA set= [62, 468, 726, 877]  
 Negative protein set= [62]  
 Iteration count=9974  
 AUROC=0.9222546850535467  
 AUPR=0.6038565262717728



NRLMF CVS-3 ROC Curve DS-6

NRLMF CVS-3 PR Curve DS-6

+++ NRLMF CVS-3: Dataset-7 +++

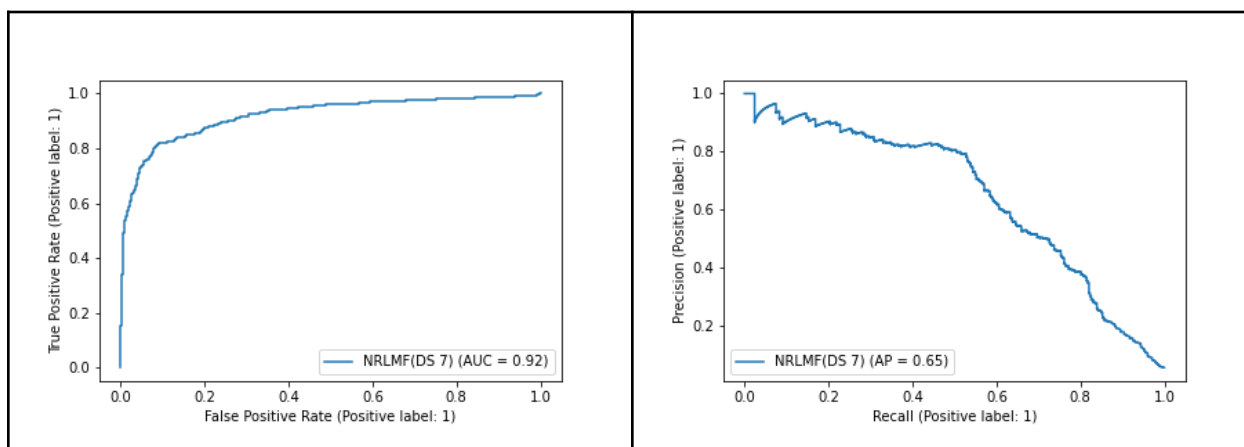
Negative RNA set= [122, 158, 210, 503, 732, 816, 839, 851]

Negative protein set= []

Iteration count=9887

AUROC=0.9201249528481937

AUPR=0.6498619931507696



NRLMF CVS-3 ROC Curve DS-7

NRLMF CVS-3 PR Curve DS-7

+++ NRLMF CVS-3: Dataset-8 +++

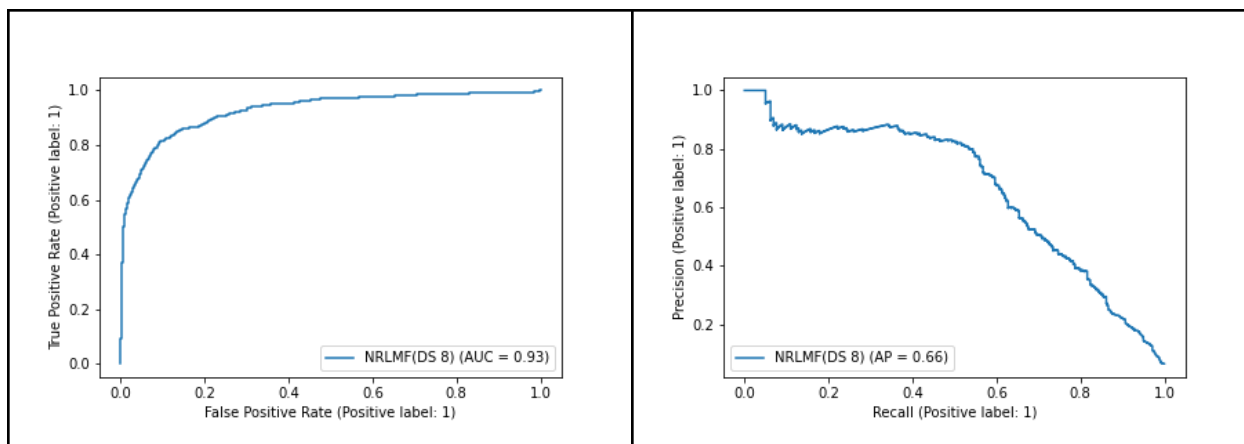
Negative RNA set= [7, 43, 467, 521, 617, 751, 879, 900, 983]

Negative protein set= []

Iteration count=11483

AUROC=0.9265975670603249

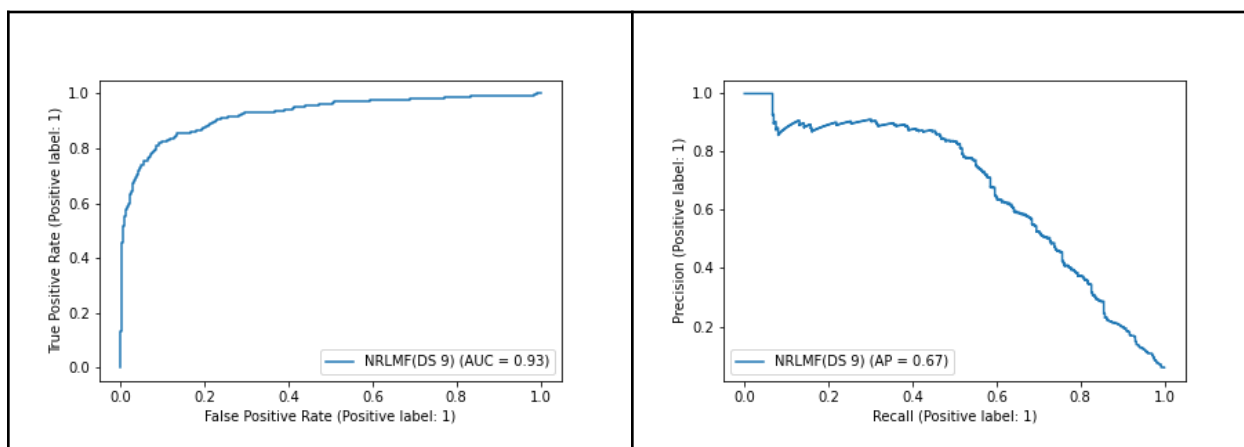
AUPR=0.663888287809885



NRLMF CVS-3 ROC Curve DS-8

NRLMF CVS-3 PR Curve DS-8

+++ NRLMF CVS-3: Dataset-9 +++  
 Negative RNA set= [451, 555, 587]  
 Negative protein set= []  
 Iteration count=9442  
 AUROC=0.9254799110946871  
 AUPR=0.6710678270069994



NRLMF CVS-3 ROC Curve DS-9

NRLMF CVS-3 PR Curve DS-9

AVERAGE RESULTS CVS-3:  
 AUROC (arithmetic mean) = **0.9242233816475631**  
 AUPR (arithmetic mean) = **0.659933260090064**

