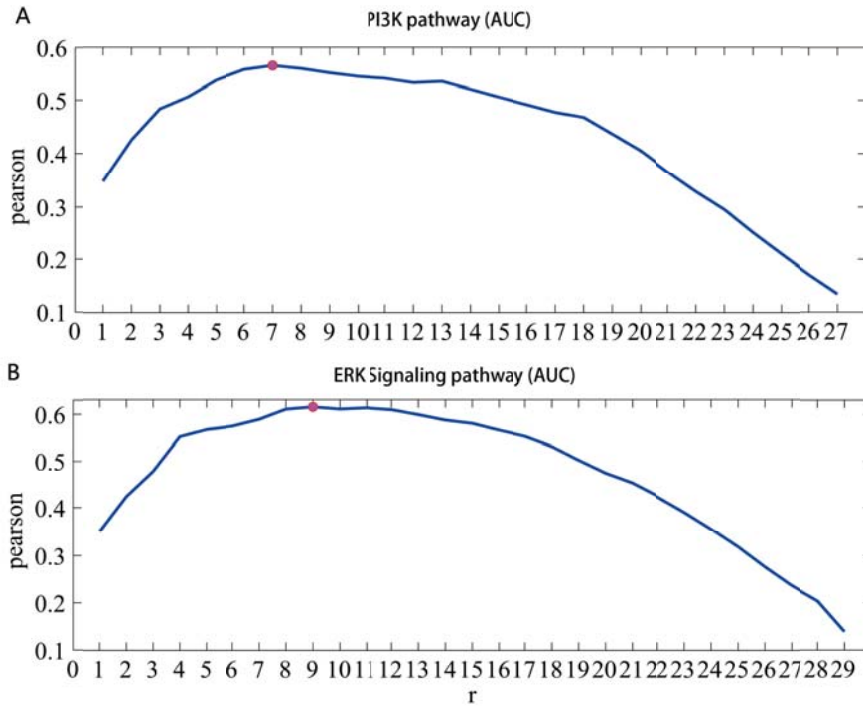# Supplemental Information

An Improved Anticancer Drug-Response Prediction

Based on an Ensemble Method Integrating

Matrix Completion and Ridge Regression

Chuanying Liu, Dong Wei, Ju Xiang, Fuquan Ren, Li Huang, Jidong Lang, Geng Tian, Yushuang Li, and Jialiang Yang

S1 Figure. The parameter r optimization for MC model in two datasets. The horizontal axis denotes the rank number, and the vertical axis denotes the Pearson correlation between predicted and observed response values. (A) r optimization in PI3K. (B) r optimization in ERK.
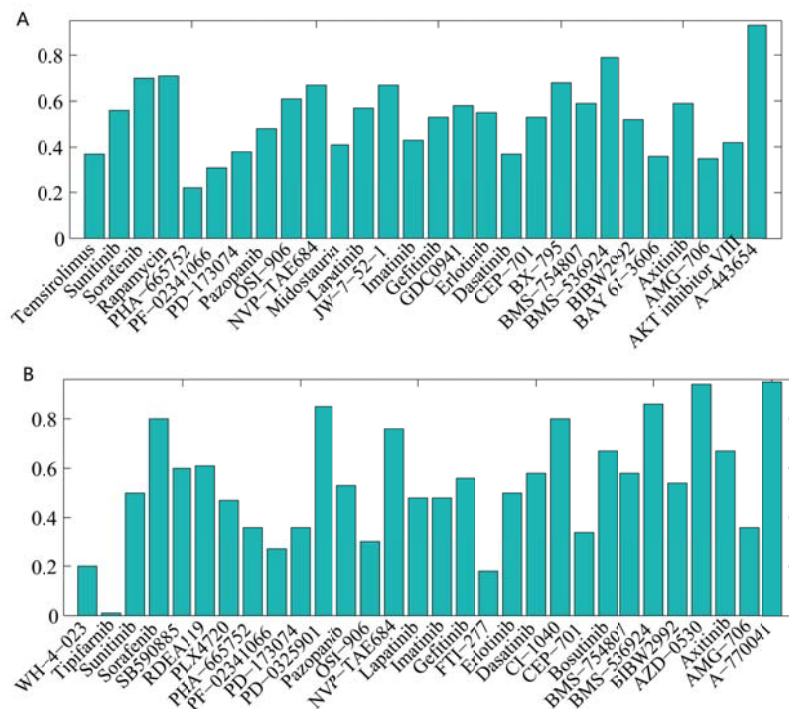
S2 Figure. The weight parameter β_k optimization for the combination model in two datasets. (A) β_k optimization in PI3K. (B) β_k optimization in ERK.
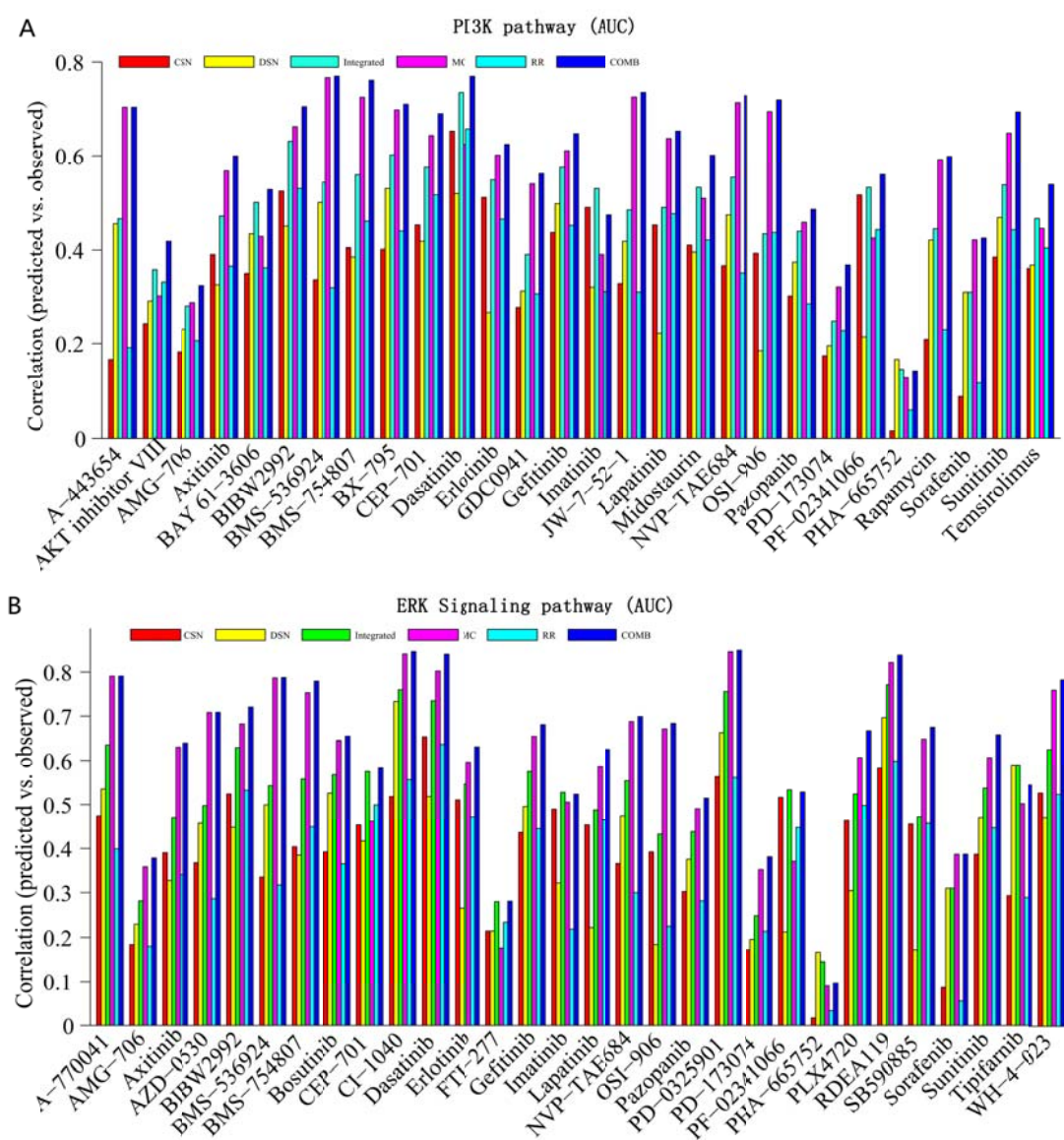
S3 Figure. Prediction performance comparison of six different models based on Pearson correlations between the predicted and observed response values. (A) Bar graph for 28 drugs in PI3K. (B) Bar graph for 30 drugs in ERK.
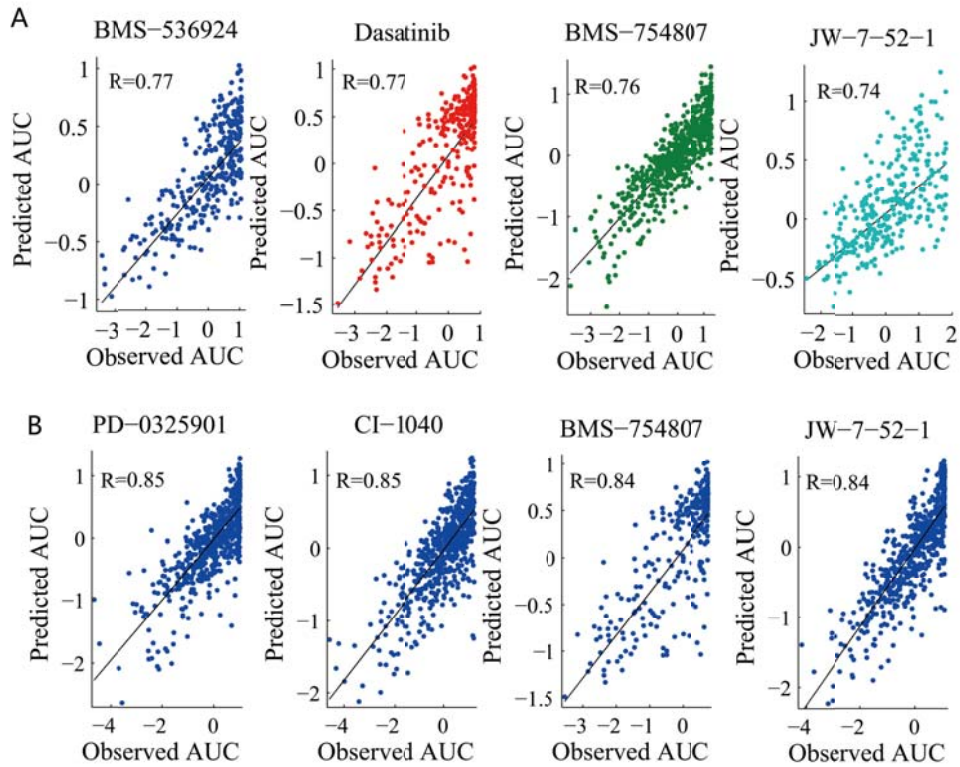
S4 Figure. Scatter plots of observed and predicted drug responses using the combination model. (A) Scatter plots for four example drugs in PI3K. (B) Scatter plots for four example drugs in ERK.
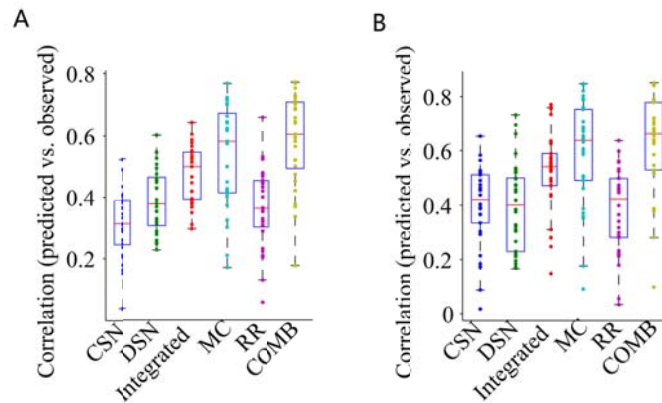
S5 Figure. The correlation distribution comparisons of six different models in two datasets. (A) Boxplot in PI3K. (B) Boxplot in ERK.
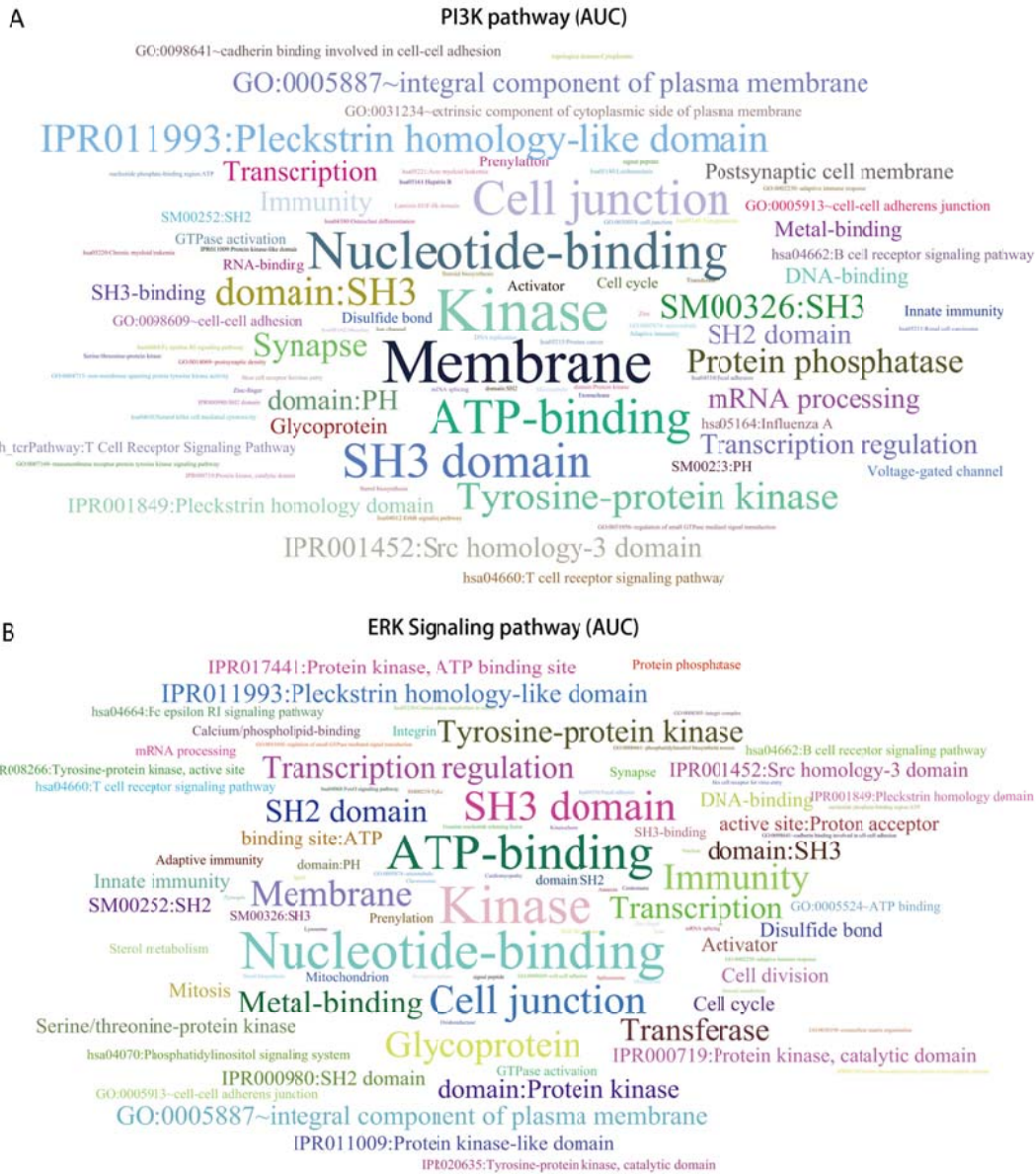
S6 Figure. Word cloud plot of functional annotations existing in at least 2 drugs in two datasets. (A) for 86 functional annotations in PI3K. (B) for 93 functional annotations in ERK.
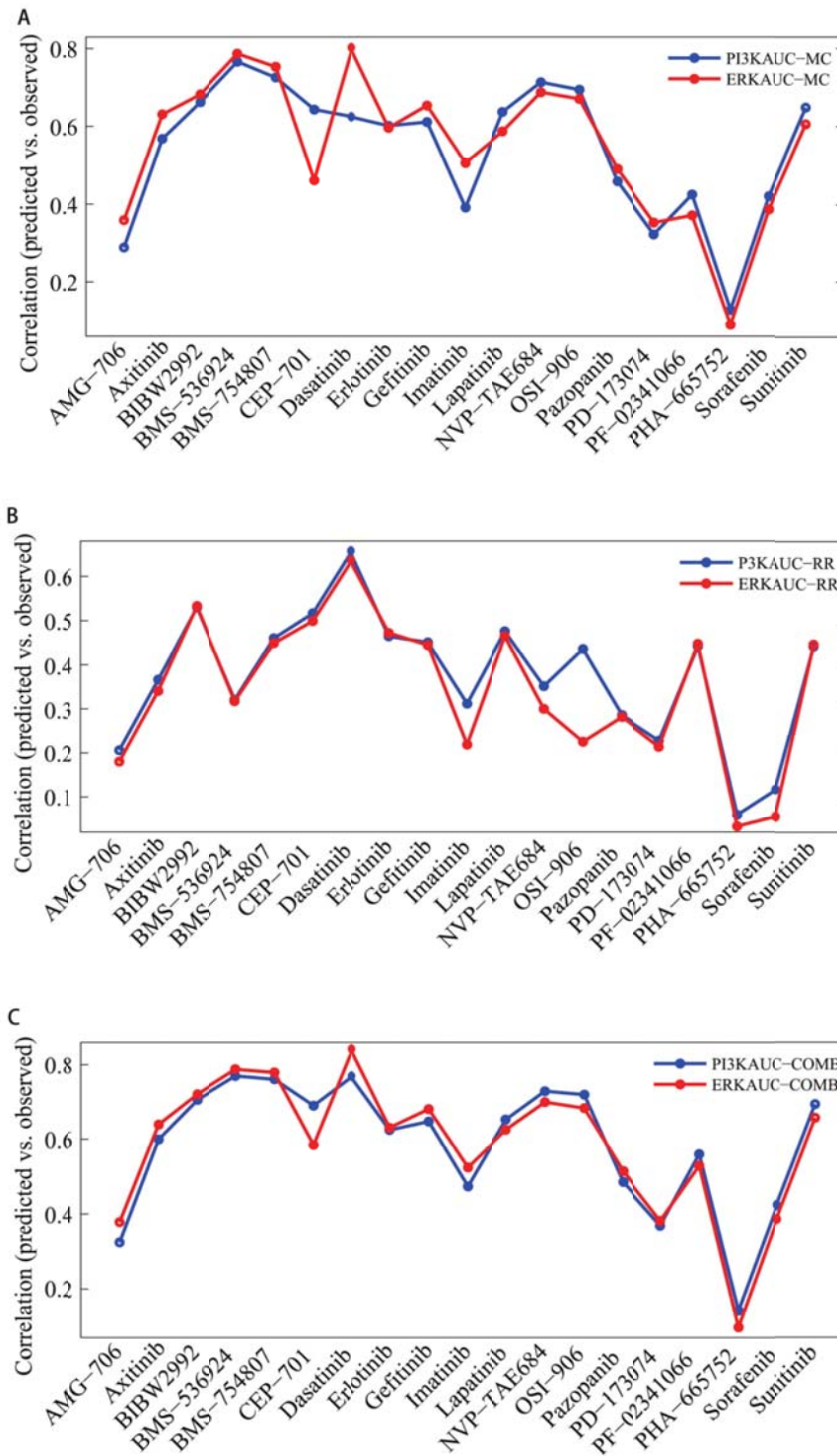
S7 Figure. Prediction comparisons of 19 common drugs in PI3K and ERK based on three models. (A) Prediction comparison using MC model. (B) Prediction comparison using RR model. (C) Prediction comparison using the combination model.

S1 Table. Optimal parameters in MC model

Parameter	CCLE	PI3K	ERK
θ_1	0.01	0.01	0.01
r	6	7	9

S2 Table (A). Parameters $\widehat{\sigma_k}$ and the number of key feature genes for 24 drugs in CCLE

k	Drugs in CCLE	$\widehat{\sigma_k}$	minimum number	maximum number
1	17-AAG	0.15	571	897
2	AEW541	0.18	472	1364
3	AZD0530	0.15	430	902
4	AZD6244	0.2	487	781
5	Erlotinib	0.2	450	816
6	Irinotecan	0.37	525	951
7	L-685458	0.32	442	834
8	LBW242	0.11	443	672
9	Lapatinib	0.24	452	680
10	Nilotinib	0.26	534	1043
11	Nutlin-3	0.17	416	1247
12	PD-0325901	0.21	451	687
13	PD-0332991	0.3	512	1195
14	PF2341066	0.22	547	1355
15	PHA-665752	0.18	553	1484
16	PLX4720	0.2	451	742
17	Paclitaxel	0.26	459	911
18	Panobinostat	0.37	505	770
19	RAF265	0.18	560	1128
20	Sorafenib	0.25	486	861
21	TAE684	0.2	455	1041
22	TKI258	0.21	503	1311
23	Topotecan	0.32	488	870
24	ZD-6474	0.15	626	1183

S2 Table (B). Parameters $\widehat{\sigma_k}$ and the number of key feature genes for 28 drugs in PI3K

k	Drugs in PI3K(AUC)	$\widehat{\sigma_k}$	minimum number	maximum number
1	A-443654	0.12	744	1669
2	AKT inhibitor VIII	0.11	644	1335
3	AMG-706	0.1	664	1536
4	Axitinib	0.12	833	1665
5	BAY 61-3606	0.15	762	1367
6	BIBW2992	0.18	857	1284
7	BMS-536924	0.16	753	1470
8	BMS-754807	0.15	608	1014
9	BX-795	0.16	705	1239
10	CEP-701	0.2	600	1150
11	Dasatinib	0.3	668	1021
12	Erlotinib	0.21	682	1221
13	GDC0941	0.11	685	1551
14	Gefitinib	0.13	794	1416
15	Imatinib	0.11	788	1823
16	JW-7-52-1	0.16	810	1743
17	Lapatinib	0.23	690	1393
18	Midostaurin	0.15	807	1243
19	NVP-TAE684	0.13	764	1395
20	OSI-906	0.11	745	1591
21	Pazopanib	0.12	628	1273
22	PD-173074	0.11	711	1604
23	PF-02341066	0.13	639	1744
24	PHA-665752	0.11	604	1153
25	Rapamycin	0.13	766	1723
26	Sorafenib	0.11	641	1339
27	Sunitinib	0.19	666	1226
28	Temsirolimus	0.13	665	1088

S2 Table (C). Parameters $\widehat{\sigma_k}$ and the number of key feature genes for 30 drugs in ERK

k	Drugs in ERK(AUC)	$\widehat{\sigma_k}$	minimum number	maximum number
1	A-770041	0.19	623	1290
2	AMG-706	0.1	657	1295
3	Axitinib	0.13	659	1261
4	AZD-0530	0.13	764	1900
5	BIBW2992	0.2	611	920
6	BMS-536924	0.16	677	1404
7	BMS-754807	0.14	788	1330
8	Bosutinib	0.12	834	1464
9	CEP-701	0.2	646	1246
10	CI-1040	0.17	760	1253
11	Dasatinib	0.3	650	1052
12	Erlotinib	0.2	757	1500
13	FTI-277	0.13	636	1315
14	Gefitinib	0.14	687	1151
15	Imatinib	0.1	786	2385
16	Lapatinib	0.22	687	1640
17	NVP-TAE684	0.13	763	1300
18	OSI-906	0.11	805	1488
19	Pazopanib	0.11	781	1705
20	PD-0325901	0.21	653	1303
21	PD-173074	0.11	840	1574
22	PF-02341066	0.13	666	1653
23	PHA-665752	0.1	769	1692
24	PLX4720	0.14	663	1109
25	RDEA119	0.21	684	1171
26	SB590885	0.13	605	1132
27	Sorafenib	0.11	645	1205
28	Sunitinib	0.19	599	1227
29	Tipifarnib	0.1	860	1805
30	WH-4-023	0.22	722	1538

S3 Table (A). Optimal parameters in RR and combination models for 24 drugs in CCLE

k	Drugs in CCLE	τ_k	θ_2	β_k
1	17-AAG	0.09	1161.6	0.33
2	AEW541	0.19	739.2	0.59
3	AZD0530	0.07	16830	0.71
4	AZD6244	0.2	1458.6	0.7
5	Erlotinib	0.13	9152	0.66
6	Irinotecan	0.33	517	0.71
7	L-685458	0.23	15730	0.61
8	LBW242	0.02	8.64E-07	0.6
9	Lapatinib	0.24	1814.4	0.46
10	Nilotinib	0.17	6072	0.52
11	Nutlin-3	0.15	12342	1
12	PD-0325901	0.23	950.4	0.64
13	PD-0332991	0.29	6336	0.74
14	PF2341066	0.18	6864	0.73
15	PHA-665752	0.09	20790	0.69
16	PLX4720	0.13	1612.8	0.46
17	Paclitaxel	0.2	165	0.47
18	Panobinostat	0.29	1320	0.4
19	RAF265	0.1	2730	0.57
20	Sorafenib	0.23	5060	0.6
21	TAE684	0.16	2310	0.67
22	TKI258	0.12	7700	0.65
23	Topotecan	0.33	214.2	0.53
24	ZD-6474	0.08	6204	0.68

S3 Table (B). Optimal parameters in RR and combination models for 28 drugs in PI3K

k	Drugs in PI3K(AUC)	τ_k	θ_2	β_k
1	A-443654	0.03	27720	0.93
2	AKT inhibitor VIII	0.05	5.64E-07	0.42
3	AMG-706	0.13	4950	0.35
4	Axitinib	0.1	739.2	0.59
5	BAY 61-3606	0.09	16940	0.36
6	BIBW2992	0.1	8800	0.52
7	BMS-536924	0.13	5940	0.79
8	BMS-754807	0.13	1100	0.59
9	BX-795	0.14	4950	0.68
10	CEP-701	0.16	2016	0.53
11	Dasatinib	0.27	4950	0.37
12	Erlotinib	0.14	7392	0.55
13	GDC0941	0.07	4950	0.58
14	Gefitinib	0.04	9900	0.53
15	Imatinib	0.02	945	0.43
16	JW-7-52-1	0.15	7854	0.67
17	Lapatinib	0.21	11858	0.57
18	Midostaurin	0.08	7546	0.41
19	NVP-TAE684	0.16	1134	0.67
20	OSI-906	0.06	2142	0.61
21	Pazopanib	0.1	10098	0.48
22	PD-173074	0.06	6732	0.38
23	PF-02341066	0.12	2356.2	0.31
24	PHA-665752	0.05	107800	0.22
25	Rapamycin	0.08	10780	0.71
26	Sorafenib	0.09	13464	0.7
27	Sunitinib	0.16	1965.6	0.56
28	Temsirolimus	0.1	4950	0.37

S3 Table (C). Optimal parameters in RR and combination models for 30 drugs in ERK

k	Drugs in ERK(AUC)	τ_k	θ_2	β_k
1	A-770041	0.2	1650	0.95
2	AMG-706	0.13	4950	0.36
3	Axitinib	0.07	279	0.67
4	AZD-0530	0.16	594	0.94
5	BIBW2992	0.16	4950	0.54
6	BMS-536924	0.17	2217.6	0.86
7	BMS-754807	0.11	1544.4	0.58
8	Bosutinib	0.12	2058	0.67
9	CEP-701	0.16	1528.8	0.34
10	CI-1040	0.14	4950	0.8
11	Dasatinib	0.27	4950	0.58
12	Erlotinib	0.13	7546	0.5
13	FTI-277	0.04	181500	0.18
14	Gefitinib	0.05	11858	0.56
15	Imatinib	0.01	45	0.48
16	Lapatinib	0.21	10560	0.48
17	NVP-TAE684	0.15	1310.4	0.76
18	OSI-906	0.07	2142	0.3
19	Pazopanib	0.09	7546	0.53
20	PD-0325901	0.21	1558.2	0.85
21	PD-173074	0.06	7854	0.36
22	PF-02341066	0.13	2184	0.27
23	PHA-665752	0.05	102960	0.36
24	PLX4720	0.15	1650	0.47
25	RDEA119	0.2	1401.4	0.61
26	SB590885	0.16	4950	0.6
27	Sorafenib	0.04	49500	0.8
28	Sunitinib	0.15	2142	0.5
29	Tipifarnib	0.01	12826	0.36

| 30 | WH-4-023 | 0.2 | 4950 | 0.67 |

S4 Table. Prediction performance of MC model in two datasets

Dataset	$\geq$ CSN (%)	$\geq$ DSN (%)	$\geq$ Integrated (%)
PI3K	89	96	71
ERK	93	90	80

S5 Table. Prediction performance of RR model in two datasets

Dataset	$\geq$ CSN (%)	$\geq$ DSN (%)	$\geq$ Integrated (%)
PI3K	71	46	4
ERK	40	47	0