Luminex_DataAnalysis

Elise Viox

November 15th, 2018

```
```

R Markdown

Analyze Luminex Data

Generate Practice Luminex Data

Multiple practice tables were created with data similar to what we might obtain from running Luminex and combined into one table.

Create Datatable 1

```
#Create "fake1" datatable
library(knitr)
library(kableExtra)
library(data.table)
donor<-c(rep("A_SMpos", 6), rep("B_SMneg",6), rep("C_SMneg",6), rep("D_SMneg",6), rep("E_SMpos",6), rep
stim<-rep(c("un","w","p","s","sw","sb"),3)
ifng<-rnorm(70, 2)
tnfa<-rnorm(70,10)
IL4<-rnorm(70,5)
IL5<-rnorm(70,7)
IL10<-rnorm(70,13)
IL13<-rnorm(70,19)
IL17<-rnorm(70,17)
IL21<-rnorm(70,11)
IL22<-rnorm(70,3)

fake1<-as.data.table(cbind(donor,stim,ifng,tnfa,IL4, IL5, IL10, IL13, IL17, IL21, IL22))
fake1$ifng=as.numeric(as.character(fake1$ifng))
fake1$tnfa=as.numeric(as.character(fake1$tnfa))
fake1$IL4=as.numeric(as.character(fake1$IL4))
fake1$IL5=as.numeric(as.character(fake1$IL5))
fake1$IL10=as.numeric(as.character(fake1$IL10))
fake1$IL13=as.numeric(as.character(fake1$IL13))
fake1$IL17=as.numeric(as.character(fake1$IL17))
fake1$IL21=as.numeric(as.character(fake1$IL21))
fake1$IL22=as.numeric(as.character(fake1$IL22))

#Print "fake1" datatable
library(knitr)
kable(fake1) %>% kable_styling(latex_options="scale_down")
```

donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
A_SMpos	un	1.2245890	11.778319	4.176510	7.394852	14.366933	18.83158	18.62745	13.066689	1.654972
A_SMpos	w	2.0233601	10.616460	4.392769	6.471233	13.772241	20.03429	14.99263	12.489899	2.400956
A_SMpos	p	1.8734075	8.635304	5.418226	6.824223	11.770744	19.92825	17.49390	11.702978	4.330728
A_SMpos	s	2.0843152	10.265275	4.790794	6.723318	12.744177	20.09474	17.27954	10.404157	2.934991
A_SMpos	sw	1.0769092	9.791105	3.211760	7.363167	14.570076	18.97028	17.86690	9.424686	3.810592
A_SMpos	sb	1.3865422	8.880026	5.872275	7.337301	13.225577	18.31740	17.31171	10.671426	3.143661
B_SMneg	un	3.0284220	9.942781	3.373573	6.122953	12.511907	18.84908	17.83868	11.561636	2.450501
B_SMneg	w	1.7735107	11.534424	5.550583	6.362840	14.723140	19.60157	17.07286	9.685464	3.135687
B_SMneg	p	2.0818775	9.917585	3.645345	5.617526	13.855197	18.89059	15.62987	9.800390	4.111269
B_SMneg	s	1.2906788	9.253460	4.551482	7.237275	13.422013	17.75711	15.62313	9.960167	1.944506
B_SMneg	sw	1.7671780	9.052639	4.320087	6.820395	13.535722	18.26823	17.67565	11.496393	2.855412
B_SMneg	sb	1.7894245	10.205572	5.017204	6.871255	13.165649	19.35829	16.83258	9.192755	3.570446
C_SMneg	un	1.1524707	10.973830	4.438291	6.771326	12.666269	17.25749	16.87973	10.707052	2.390605
C_SMneg	w	3.3421694	9.710743	3.117895	7.331474	12.901234	18.93955	17.97817	11.422882	3.403175
C_SMneg	p	0.7192464	8.849250	5.596580	7.414849	12.652797	20.65463	15.61381	10.128320	3.757290
C_SMneg	s	3.0880224	8.777129	3.833406	5.815086	14.273485	20.33369	16.93344	12.980498	3.973700
C_SMneg	sw	4.3010122	9.961081	5.917031	8.047496	13.426071	19.57184	16.11159	10.485651	4.401490
C_SMneg	sb	0.0479729	10.179052	5.798959	7.893204	12.531417	20.39951	17.14733	11.250427	2.331744
D_SMneg	un	2.8548216	9.211446	4.500456	8.809123	12.456639	18.35376	17.45584	12.072876	2.536111
D_SMneg	w	1.5382136	11.870062	4.504540	8.579923	13.289193	17.03881	17.23374	10.313330	4.622989
D_SMneg	p	3.3102810	8.965868	5.925581	5.509438	13.003774	18.83454	16.82980	10.080244	3.462704
D_SMneg	s	2.2786475	9.501402	3.219218	6.674602	11.420031	18.12531	18.46174	9.681653	2.980723
D_SMneg	sw	2.5012998	11.256317	5.978418	8.003214	14.093311	19.32220	16.95533	11.555914	4.452405
D_SMneg	sb	0.8668985	7.865543	4.709626	5.484749	12.518467	19.11042	17.94757	11.017534	3.064637
E_SMpos	un	1.0202145	8.604847	5.856313	6.994272	9.842017	19.27939	15.91967	12.923399	4.045546
E_SMpos	w	2.6056434	10.523405	5.215451	7.517863	12.138169	19.77805	16.50091	9.982125	1.896272
E_SMpos	p	0.6013112	8.835214	3.123827	7.773491	12.553212	16.91905	17.31690	11.932169	1.935181
E_SMpos	s	0.8396565	10.372774	4.718849	8.367093	13.098592	18.64031	15.52159	10.545326	3.653813
E_SMpos	sw	2.7070334	7.668059	5.896147	8.430689	12.926019	20.08289	16.82656	10.154061	4.034930
E_SMpos	sb	1.3399961	10.432844	4.961254	5.959061	13.526673	18.13090	17.91539	11.140532	3.360530
F_SMpos	un	1.1089689	10.152818	4.706963	6.057703	11.722071	19.42656	20.42190	11.438986	4.960241
F_SMpos	w	0.9314907	10.133401	5.130127	7.410813	12.970503	20.17940	19.18816	11.936671	2.741093
F_SMpos	p	1.2244452	10.119343	5.261671	8.986393	12.022255	16.79281	16.80626	10.538298	4.765674
F_SMpos	s	1.0071515	11.323089	5.141189	7.765670	12.913593	18.94957	16.63000	10.054461	2.938103
F_SMpos	sw	2.7758239	11.181101	4.379994	7.245393	12.321730	19.53432	16.72596	11.457598	5.574408
F_SMpos	sb	2.1131696	9.662969	5.608451	5.924690	13.388232	17.28363	16.69862	12.329284	3.198824
G_SMneg	un	2.6812623	9.223047	4.697783	6.859319	14.371169	19.22294	16.72470	9.893850	2.978931
G_SMneg	w	0.3734708	10.241049	2.809254	7.370427	11.301505	19.84389	17.96291	12.632260	5.129545
G_SMneg	p	3.6653186	8.513815	5.566405	5.799791	12.603123	16.93774	16.55513	10.293913	3.916374
G_SMneg	s	0.1306156	10.693133	4.589264	6.616172	12.624853	18.44432	15.04374	12.054187	2.025803
G_SMneg	sw	0.4973303	10.934014	4.051669	7.176783	12.700304	20.49748	18.12606	10.504631	3.105660
G_SMneg	sb	2.2668705	7.566026	4.500888	6.434873	11.599279	18.35112	15.07305	10.032359	2.421737
H_SMneg	un	1.0408891	11.500933	3.945782	8.427912	13.218664	18.17017	16.40159	9.319326	4.967785
H_SMneg	w	0.9442606	8.606707	4.861664	6.437123	13.700666	17.97084	19.67940	9.536896	2.086558
H_SMneg	p	2.3383377	10.935614	3.900417	7.596547	12.264416	20.24439	17.02500	11.174367	2.395191
H_SMneg	s	0.7974551	10.245433	6.239608	6.967676	11.430283	18.87354	19.51989	10.289846	2.372092
H_SMneg	sw	-0.1672168	11.335122	2.948804	8.821104	12.364425	19.47588	16.36326	11.017920	4.890348
H_SMneg	sb	1.7327567	8.744341	3.840022	6.063371	13.755297	20.55594	16.28416	11.245449	4.116672
I_SMneg	un	2.7040142	10.951080	6.252247	7.700462	12.115825	20.32869	19.35539	12.185982	3.241399
I_SMneg	w	1.9009361	10.072666	4.007751	6.809534	13.618943	18.89826	16.71838	8.667879	4.556871
I_SMneg	p	2.4626383	10.114328	3.807425	6.660944	12.953076	18.12823	16.40109	10.648735	3.605609
I_SMneg	s	2.7285365	11.155838	4.989928	7.144680	13.073322	18.01471	16.68898	11.493621	3.222464
I_SMneg	sw	1.9813263	8.364567	3.826304	7.831802	13.657665	19.65605	16.69237	11.269315	3.366683
I_SMneg	sb	0.6392921	9.927551	5.946650	7.079841	13.519997	17.51253	16.20567	11.113536	2.543318
J_SMpos	un	1.9700117	9.777047	5.202806	6.669002	11.666574	18.53812	16.53045	11.062259	3.055943
J_SMpos	w	1.2112392	8.645129	5.345701	6.117845	12.888675	19.33448	15.17080	11.173378	3.043079
J_SMpos	p	0.4256026	9.577173	5.100577	6.431837	13.206443	19.86842	15.53912	12.074466	4.338440
J_SMpos	s	0.9943484	9.187867	5.694242	6.887722	13.695194	20.11125	15.30330	10.299243	3.961558
J_SMpos	sw	2.8723434	9.643228	5.327902	7.011411	12.112009	19.00253	16.60540	11.489254	4.347064
J_SMpos	sb	2.2590923	9.891320	5.540267	6.737926	13.203351	20.95872	16.56247	10.836153	3.854089
K_SMpos	un	1.0359990	8.981107	4.590926	6.634350	12.532641	18.27446	16.39707	9.117972	3.969193
K_SMpos	w	2.4551879	7.666910	6.038457	7.495659	12.606551	17.28791	15.59024	10.407003	4.346115
K_SMpos	p	2.6402438	10.214696	6.399016	7.681001	12.914602	20.84682	17.48197	10.380965	3.251212
K_SMpos	s	2.6948061	9.581978	4.521119	7.524890	11.323299	17.05612	15.92798	12.201087	3.377975
K_SMpos	sw	1.5628908	9.557805	4.691687	7.808186	13.732327	18.68531	17.95458	9.247912	2.686574
K_SMpos	sb	2.8151532	9.897176	4.351030	7.215685	12.966556	19.90183	16.02480	12.079831	3.273173
L_SMpos	un	1.9938347	10.277660	5.171916	6.884330	13.659446	18.51500	17.87779	11.855640	1.673376
L_SMpos	w	0.9623999	10.841769	4.600720	6.938003	13.526483	18.65667	16.32391	9.228207	2.717712
L_SMpos	p	0.6774859	8.989619	5.226276	8.642592	13.790128	17.52533	17.42571	10.553025	2.253732
L_SMpos	s	1.4781367	9.137599	5.555133	6.428775	12.443585	20.07737	19.51317	11.470405	2.221941

```
#Write "fake1" csv
setwd("/Users/eviox/Documents/Emory_IMP/Rotations/Day_Lab/Luminex/FakeData/")
write.csv(fake1,"fake1.csv")
```

Create Datatable 2

```
#Create "fake2" datatable
library(knitr)
library(kableExtra)
library(data.table)
donor<-c(rep("N_SMpos",6), rep("O_SMpos",6), rep("P_SMpos",6), rep("Q_SMneg",6), rep("R_SMpos",6), rep(
stim<-rep(c("un","w","p","s","sw","sb"),3)
ifng<-rnorm(70, 2)
tnfa<-rnorm(70,10)
IL4<-rnorm(70,5)
IL5<-rnorm(70,7)
IL10<-rnorm(70,13)
IL13<-rnorm(70,19)
IL17<-rnorm(70,17)
IL21<-rnorm(70,11)
IL22<-rnorm(70,3)

fake2<-as.data.table(cbind(donor,stim,ifng,tnfa,IL4, IL5, IL10, IL13, IL17, IL21, IL22))
fake2$ifng=as.numeric(as.character(fake1$ifng))
fake2$tnfa=as.numeric(as.character(fake1$tnfa))
fake2$IL4=as.numeric(as.character(fake1$IL4))
fake2$IL5=as.numeric(as.character(fake1$IL5))
fake2$IL10=as.numeric(as.character(fake1$IL10))
fake2$IL13=as.numeric(as.character(fake1$IL13))
fake2$IL17=as.numeric(as.character(fake1$IL17))
fake2$IL21=as.numeric(as.character(fake1$IL21))
fake2$IL22=as.numeric(as.character(fake1$IL22))

#Print "fake2" datatable
library(knitr)
kable(fake2) %>% kable_styling(latex_options="scale_down")
```

donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
N_SMpos	un	1.2245890	11.778319	4.176510	7.394852	14.366933	18.83158	18.62745	13.066689	1.654972
N_SMpos	w	2.0233601	10.616460	4.392769	6.471233	13.772241	20.03429	14.99263	12.489899	2.400956
N_SMpos	p	1.8734075	8.635304	5.418226	6.824223	11.770744	19.92825	17.49390	11.702978	4.330728
N_SMpos	s	2.0843152	10.265275	4.790794	6.723318	12.744177	20.09474	17.27954	10.404157	2.934991
N_SMpos	sw	1.0769092	9.791105	3.211760	7.363167	14.570076	18.97028	17.86690	9.424686	3.810592
N_SMpos	sb	1.3865422	8.880026	5.872275	7.337301	13.225577	18.31740	17.31171	10.671426	3.143661
O_SMpos	un	3.0284220	9.942781	3.373573	6.122953	12.511907	18.84908	17.83868	11.561636	2.450501
O_SMpos	w	1.7735107	11.534424	5.550583	6.362840	14.723140	19.60157	17.07286	9.685464	3.135687
O_SMpos	p	2.0818775	9.917585	3.645345	5.617526	13.855197	18.89059	15.62987	9.800390	4.111269
O_SMpos	s	1.2906788	9.253460	4.551482	7.237275	13.422013	17.75711	15.62313	9.960167	1.944506
O_SMpos	sw	1.7671780	9.052639	4.320087	6.820395	13.535722	18.26823	17.67565	11.496393	2.855412
O_SMpos	sb	1.7894245	10.205572	5.017204	6.871255	13.165649	19.35829	16.83258	9.192755	3.570446
P_SMpos	un	1.1524707	10.973830	4.438291	6.771326	12.666269	17.25749	16.87973	10.707052	2.390605
P_SMpos	w	3.3421694	9.710743	3.117895	7.331474	12.901234	18.93955	17.97817	11.422882	3.403175
P_SMpos	p	0.7192464	8.849250	5.596580	7.414849	12.652797	20.65463	15.61381	10.128320	3.757290
P_SMpos	s	3.0880224	8.777129	3.833406	5.815086	14.273485	20.33369	16.93344	12.980498	3.973700
P_SMpos	sw	4.3010122	9.961081	5.917031	8.047496	13.426071	19.57184	16.11159	10.485651	4.401490
P_SMpos	sb	0.0479729	10.179052	5.798959	7.893204	12.531417	20.39951	17.14733	11.250427	2.331744
Q_SMneg	un	2.8548216	9.211446	4.500456	8.809123	12.456639	18.35376	17.45584	12.072876	2.536111
Q_SMneg	w	1.5382136	11.870062	4.504540	8.579923	13.289193	17.03881	17.23374	10.313330	4.622989
Q_SMneg	p	3.3102810	8.965868	5.925581	5.509438	13.003774	18.83454	16.82980	10.080244	3.462704
Q_SMneg	s	2.2786475	9.501402	3.219218	6.674602	11.420031	18.12531	18.46174	9.681653	2.980723
Q_SMneg	sw	2.5012998	11.256317	5.978418	8.003214	14.093311	19.32220	16.95533	11.555914	4.452405
Q_SMneg	sb	0.8668985	7.865543	4.709626	5.484749	12.518467	19.11042	17.94757	11.017534	3.064637
R_SMpos	un	1.0202145	8.604847	5.856313	6.994272	9.842017	19.27939	15.91967	12.923399	4.045546
R_SMpos	w	2.6056434	10.523405	5.215451	7.517863	12.138169	19.77805	16.50091	9.982125	1.896272
R_SMpos	p	0.6013112	8.835214	3.123827	7.773491	12.553212	16.91905	17.31690	11.932169	1.935181
R_SMpos	s	0.8396565	10.372774	4.718849	8.367093	13.098592	18.64031	15.52159	10.545326	3.653813
R_SMpos	sw	2.7070334	7.668059	5.896147	8.430689	12.926019	20.08289	16.82656	10.154061	4.034930
R_SMpos	sb	1.3399961	10.432844	4.961254	5.959061	13.526673	18.13090	17.91539	11.140532	3.360530
S_SMneg	un	1.1089689	10.152818	4.706963	6.057703	11.722071	19.42656	20.42190	11.438986	4.960241
S_SMneg	w	0.9314907	10.133401	5.130127	7.410813	12.970503	20.17940	19.18816	11.936671	2.741093
S_SMneg	p	1.2244452	10.119343	5.261671	8.986393	12.022255	16.79281	16.80626	10.538298	4.765674
S_SMneg	s	1.0071515	11.323089	5.141189	7.765670	12.913593	18.94957	16.63000	10.054461	2.938103
S_SMneg	sw	2.7758239	11.181101	4.379994	7.245393	12.321730	19.53432	16.72596	11.457598	5.574408
S_SMneg	sb	2.1131696	9.662969	5.608451	5.924690	13.388232	17.28363	16.69862	12.329284	3.198824
T_SMneg	un	2.6812623	9.223047	4.697783	6.859319	14.371169	19.22294	16.72470	9.893850	2.978931
T_SMneg	w	0.3734708	10.241049	2.809254	7.370427	11.301505	19.84389	17.96291	12.632260	5.129545
T_SMneg	p	3.6653186	8.513815	5.566405	5.799791	12.603123	16.93774	16.55513	10.293913	3.916374
T_SMneg	s	0.1306156	10.693133	4.589264	6.616172	12.624853	18.44432	15.04374	12.054187	2.025803
T_SMneg	sw	0.4973303	10.934014	4.051669	7.176783	12.700304	20.49748	18.12606	10.504631	3.105660
T_SMneg	sb	2.2668705	7.566026	4.500888	6.434873	11.599279	18.35112	15.07305	10.032359	2.421737
U_SMneg	un	1.0408891	11.500933	3.945782	8.427912	13.218664	18.17017	16.40159	9.319326	4.967785
U_SMneg	w	0.9442606	8.606707	4.861664	6.437123	13.700666	17.97084	19.67940	9.536896	2.086558
U_SMneg	p	2.3383377	10.935614	3.900417	7.596547	12.264416	20.24439	17.02500	11.174367	2.395191
U_SMneg	s	0.7974551	10.245433	6.239608	6.967676	11.430283	18.87354	19.51989	10.289846	2.372092
U_SMneg	sw	-0.1672168	11.335122	2.948804	8.821104	12.364425	19.47588	16.36326	11.017920	4.890348
U_SMneg	sb	1.7327567	8.744341	3.840022	6.063371	13.755297	20.55594	16.28416	11.245449	4.116672
V_SMneg	un	2.7040142	10.951080	6.252247	7.700462	12.115825	20.32869	19.35539	12.185982	3.241399
V_SMneg	w	1.9009361	10.072666	4.007751	6.809534	13.618943	18.89826	16.71838	8.667879	4.556871
V_SMneg	p	2.4626383	10.114328	3.807425	6.660944	12.953076	18.12823	16.40109	10.648735	3.605609
V_SMneg	s	2.7285365	11.155838	4.989928	7.144680	13.073322	18.01471	16.68898	11.493621	3.222464
V_SMneg	sw	1.9813263	8.364567	3.826304	7.831802	13.657665	19.65605	16.69237	11.269315	3.366683
V_SMneg	sb	0.6392921	9.927551	5.946650	7.079841	13.519997	17.51253	16.20567	11.113536	2.543318
W_SMpos	un	1.9700117	9.777047	5.202806	6.669002	11.666574	18.53812	16.53045	11.062259	3.055943
W_SMpos	w	1.2112392	8.645129	5.345701	6.117845	12.888675	19.33448	15.17080	11.173378	3.043079
W_SMpos	p	0.4256026	9.577173	5.100577	6.431837	13.206443	19.86842	15.53912	12.074466	4.338440
W_SMpos	s	0.9943484	9.187867	5.694242	6.887722	13.695194	20.11125	15.30330	10.299243	3.961558
W_SMpos	sw	2.8723434	9.643228	5.327902	7.011411	12.112009	19.00253	16.60540	11.489254	4.347064
W_SMpos	sb	2.2590923	9.891320	5.540267	6.737926	13.203351	20.95872	16.56247	10.836153	3.854089
X_SMpos	un	1.0359990	8.981107	4.590926	6.634350	12.532641	18.27446	16.39707	9.117972	3.969193
X_SMpos	w	2.4551879	7.666910	6.038457	7.495659	12.606551	17.28791	15.59024	10.407003	4.346115
X_SMpos	p	2.6402438	10.214696	6.399016	7.681001	12.914602	20.84682	17.48197	10.380965	3.251212
X_SMpos	s	2.6948061	9.581978	4.521119	7.524890	11.323299	17.05612	15.92798	12.201087	3.377975
X_SMpos	sw	1.5628908	9.557805	4.691687	7.808186	13.732327	18.68531	17.95458	9.247912	2.686574
X_SMpos	sb	2.8151532	9.897176	4.351030	7.213685	12.966556	19.90183	16.02480	12.079831	3.273173
Y_SMneg	un	1.9938347	10.277660	5.171916	6.884330	13.659446	18.51500	17.87779	11.855640	1.673376
Y_SMneg	w	0.9623999	10.841769	4.600720	6.938003	13.526483	18.65667	16.32391	9.228207	2.717712
Y_SMneg	p	0.6774859	8.989619	5.226276	8.642592	13.790128	17.52533	17.42571	10.553025	2.253732
Y_SMneg	s	1.4781367	9.137599	5.555122	6.428775	12.442585	20.07737	19.51317	11.470405	2.221941

```r
#Write "fake2" csv
setwd("/Users/eviox/Documents/Emory_IMP/Rotations/Day_Lab/Luminex/FakeData/")
write.csv(fake2,"fake2.csv")
```

Combine Datatables

```r
library(data.table)
library(kableExtra)
library(knitr)

#Identify directory where files of interest are located
file_names <- dir("/Users/eviox/Documents/Emory_IMP/Rotations/Day_Lab/Luminex/FakeData/")

#Set directory for new file to be stored
setwd("/Users/eviox/Documents/Emory_IMP/Rotations/Day_Lab/Luminex/FakeData/")

#Combine all files in the file_names directory into one file
fakecombined <- do.call(rbind,lapply(file_names,read.csv))
fakecombined$X <- NULL

kable(fakecombined) %>% kable_styling(latex_options="scale_down")
```

donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
A_SMpos	un	1.2245890	11.778319	4.176510	7.394852	14.366933	18.83158	18.62745	13.066689	1.654972
A_SMpos	w	2.0233601	10.616460	4.392769	6.471233	13.772241	20.03429	14.99263	12.489899	2.400956
A_SMpos	p	1.8734075	8.635304	5.418226	6.824223	11.770744	19.92825	17.49390	11.702978	4.330728
A_SMpos	s	2.0843152	10.265275	4.790794	6.723318	12.744177	20.09474	17.27954	10.404157	2.934991
A_SMpos	sw	1.0769092	9.791105	3.211760	7.363167	14.570076	18.97028	17.86690	9.424686	3.810592
A_SMpos	sb	1.3865422	8.880026	5.872275	7.337301	13.225577	18.31740	17.31171	10.671426	3.143661
B_SMneg	un	3.0284220	9.942781	3.373573	6.122953	12.511907	18.84908	17.83868	11.561636	2.450501
B_SMneg	w	1.7735107	11.534424	5.550583	6.362840	14.723140	19.60157	17.07286	9.685464	3.135687
B_SMneg	p	2.0818775	9.917585	3.645345	5.617526	13.855197	18.89059	15.62987	9.800390	4.111269
B_SMneg	s	1.2906788	9.253460	4.551482	7.237275	13.422013	17.75711	15.62313	9.960167	1.944506
B_SMneg	sw	1.7671780	9.052639	4.320087	6.820395	13.535722	18.26823	17.67565	11.496393	2.855412
B_SMneg	sb	1.7894245	10.205572	5.017204	6.871255	13.165649	19.35829	16.83258	9.192755	3.570446
C_SMneg	un	1.1524707	10.973830	4.438291	6.771326	12.666269	17.25749	16.87973	10.707052	2.390605
C_SMneg	w	3.3421694	9.710743	3.117895	7.331474	12.901234	18.93955	17.97817	11.422882	3.403175
C_SMneg	p	0.7192464	8.849250	5.596580	7.414849	12.652797	20.65463	15.61381	10.128320	3.757290
C_SMneg	s	3.0880224	8.777129	3.833406	5.815086	14.273485	20.33369	16.93344	12.980498	3.973700
C_SMneg	sw	4.3010122	9.961081	5.917031	8.047496	13.426071	19.57184	16.11159	10.485651	4.401490
C_SMneg	sb	0.0479729	10.179052	5.798959	7.893204	12.531417	20.39951	17.14733	11.250427	2.331744
D_SMneg	un	2.8548216	9.211446	4.500456	8.809123	12.456639	18.35376	17.45584	12.072876	2.536111
D_SMneg	w	1.5382136	11.870062	4.504540	8.579923	13.289193	17.03881	17.23374	10.313330	4.622989
D_SMneg	p	3.3102810	8.965868	5.925581	5.509438	13.003774	18.83454	16.82980	10.080244	3.462704
D_SMneg	s	2.2786475	9.501402	3.219218	6.674602	11.420031	18.12531	18.46174	9.681653	2.980723
D_SMneg	sw	2.5012998	11.256317	5.978418	8.003214	14.093311	19.32220	16.95533	11.555914	4.452405
D_SMneg	sb	0.8668985	7.865543	4.709626	5.484749	12.518467	19.11042	17.94757	11.017534	3.064637
E_SMpos	un	1.0202145	8.604847	5.856313	6.994272	9.842017	19.27939	15.91967	12.923399	4.045546
E_SMpos	w	2.6056434	10.523405	5.215451	7.517863	12.138169	19.77805	16.50091	9.982125	1.896272
E_SMpos	p	0.6013112	8.835214	3.123827	7.773491	12.553212	16.91905	17.31690	11.932169	1.935181
E_SMpos	s	0.8396565	10.372774	4.718849	8.367093	13.098592	18.64031	15.52159	10.545326	3.653813
E_SMpos	sw	2.7070334	7.668059	5.896147	8.430689	12.926019	20.08289	16.82656	10.154061	4.034930
E_SMpos	sb	1.3399961	10.432844	4.961254	5.959061	13.526673	18.13090	17.91539	11.140532	3.360530
F_SMpos	un	1.1089689	10.152818	4.706963	6.057703	11.722071	19.42656	20.42190	11.438986	4.960241
F_SMpos	w	0.9314907	10.133401	5.130127	7.410813	12.970503	20.17940	19.18816	11.936671	2.741093
F_SMpos	p	1.2244452	10.119343	5.261671	8.986393	12.022255	16.79281	16.80626	10.538298	4.765674
F_SMpos	s	1.0071515	11.323089	5.141189	7.765670	12.913593	18.94957	16.63000	10.054461	2.938103
F_SMpos	sw	2.7758239	11.181101	4.379994	7.245393	12.321730	19.53432	16.72596	11.457598	5.574408
F_SMpos	sb	2.1131696	9.662969	5.608451	5.924690	13.388232	17.28363	16.69862	12.329284	3.198824
G_SMneg	un	2.6812623	9.223047	4.697783	6.859319	14.371169	19.22294	16.72470	9.893850	2.978931
G_SMneg	w	0.3734708	10.241049	2.809254	7.370427	11.301505	19.84389	17.96291	12.632260	5.129545
G_SMneg	p	3.6653186	8.513815	5.566405	5.799791	12.603123	16.93774	16.55513	10.293913	3.916374
G_SMneg	s	0.1306156	10.693133	4.589264	6.616172	12.624853	18.44432	15.04374	12.054187	2.025803
G_SMneg	sw	0.4973303	10.934014	4.051669	7.176783	12.700304	20.49748	18.12606	10.504631	3.105660
G_SMneg	sb	2.2668705	7.566026	4.500888	6.434873	11.599279	18.35112	15.07305	10.032359	2.421737
H_SMneg	un	1.0408891	11.500933	3.945782	8.427912	13.218664	18.17017	16.40159	9.319326	4.967785
H_SMneg	w	0.9442606	8.606707	4.861664	6.437123	13.700666	17.97084	19.67940	9.536896	2.086558
H_SMneg	p	2.3383377	10.935614	3.900417	7.596547	12.264416	20.24439	17.02500	11.174367	2.395191
H_SMneg	s	0.7974551	10.245433	6.239608	6.967676	11.430283	18.87354	19.51989	10.289846	2.372092
H_SMneg	sw	-0.1672168	11.335122	2.948804	8.821104	12.364425	19.47588	16.36326	11.017920	4.890348
H_SMneg	sb	1.7327567	8.744341	3.840022	6.063371	13.755297	20.55594	16.28416	11.245449	4.116672
I_SMneg	un	2.7040142	10.951080	6.252247	7.700462	12.115825	20.32869	19.35539	12.185982	3.241399
I_SMneg	w	1.9009361	10.072666	4.007751	6.809534	13.618943	18.89826	16.71838	8.667879	4.556871
I_SMneg	p	2.4626383	10.114328	3.807425	6.660944	12.953076	18.12823	16.40109	10.648735	3.605609
I_SMneg	s	2.7285365	11.155838	4.989928	7.144680	13.073322	18.01471	16.68898	11.493621	3.222464
I_SMneg	sw	1.9813263	8.364567	3.826304	7.831802	13.657665	19.65605	16.69237	11.269315	3.366683
I_SMneg	sb	0.6392921	9.927551	5.946650	7.079841	13.519997	17.51253	16.20567	11.113536	2.543318
J_SMpos	un	1.9700117	9.777047	5.202806	6.669002	11.666574	18.53812	16.53045	11.062259	3.055943
J_SMpos	w	1.2112392	8.645129	5.345701	6.117845	12.888675	19.33448	15.17080	11.173378	3.043079
J_SMpos	p	0.4256026	9.577173	5.100577	6.431837	13.206443	19.86842	15.53912	12.074466	4.338440
J_SMpos	s	0.9943484	9.187867	5.694242	6.887722	13.695194	20.11125	15.30330	10.299243	3.961558
J_SMpos	sw	2.8723434	9.643228	5.327902	7.011411	12.112009	19.00253	16.60540	11.489254	4.347064
J_SMpos	sb	2.2590923	9.891320	5.540267	6.737926	13.203351	20.95872	16.56247	10.836153	3.854089
K_SMpos	un	1.0359990	8.981107	4.590926	6.634350	12.532641	18.27446	16.39707	9.117972	3.969193
K_SMpos	w	2.4551879	7.666910	6.038457	7.495659	12.606551	17.28791	15.59024	10.407003	4.346115
K_SMpos	p	2.6402438	10.214696	6.399016	7.681001	12.914602	20.84682	17.48197	10.380965	3.251212
K_SMpos	s	2.6948061	9.581978	4.521119	7.524890	11.323299	17.05612	15.92798	12.201087	3.377975
K_SMpos	sw	1.5628908	9.557805	4.691687	7.808186	13.732327	18.68531	17.95458	9.247912	2.686574
K_SMpos	sb	2.8151532	9.897176	4.351030	7.213685	12.966556	19.90183	16.02480	12.079831	3.273173
L_SMpos	un	1.9938347	10.277660	5.171916	6.884330	13.659446	18.51500	17.87779	11.855640	1.673376
L_SMpos	w	0.9623999	10.841769	4.600720	6.938003	13.526483	18.65667	16.32391	9.228207	2.717712
L_SMpos	p	0.6774859	8.989619	5.226276	8.642592	13.790128	17.52533	17.42571	10.553025	2.253732
L_SMpos	s	1.4781367	9.137599	5.555122	6.428775	12.442585	20.07737	19.51317	11.470405	2.221941

Subtract out unstimulated values

I wrote a function called "subtractun"" that pulls the unstimulated value for each cytokine from each donor and subtracts it from the respective stim values for the respective cytokine.

The function uses the 1) split, 2) apply, 3)combine sequence to 1) generate data tables for each individual donor, 2) apply the subtraction of the unstim to the respective cytokines for those donors, and 3) take these newly calculated values for individual donors and combine them into a data table containing all donor values.

The subtractun function will be applied only to the numeric columns of a datatable as specified by the "numeric.only" function. In the case of luminex data, this ensures that the function will only be applied to cytokine data.

Split table by donor

```
library(knitr)
library(kableExtra)
#Redefine donor (since previously defined for generating fake data)
donor<-fakecombined$donor
fakesplit<- split(fakecombined, donor)
kable(fakesplit$A) %>% kable_styling(latex_options="scale_down")
```

donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
A_SMpos	un	1.224589	11.778319	4.176510	7.394852	14.36693	18.83158	18.62745	13.066689	1.654972
A_SMpos	w	2.023360	10.616460	4.392769	6.471233	13.77224	20.03429	14.99263	12.489899	2.400956
A_SMpos	p	1.873407	8.635304	5.418226	6.824223	11.77074	19.92825	17.49390	11.702978	4.330728
A_SMpos	s	2.084315	10.265275	4.790794	6.723318	12.74418	20.09474	17.27954	10.404157	2.934991
A_SMpos	sw	1.076909	9.791105	3.211760	7.363167	14.57008	18.97028	17.86690	9.424686	3.810592
A_SMpos	sb	1.386542	8.880026	5.872275	7.337301	13.22558	18.31740	17.31171	10.671426	3.143661

```
kable(fakesplit$B) %>% kable_styling(latex_options="scale_down")
```

	donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
7	B_SMneg	un	3.028422	9.942781	3.373573	6.122953	12.51191	18.84908	17.83868	11.561636	2.450501
8	B_SMneg	w	1.773511	11.534424	5.550583	6.362840	14.72314	19.60157	17.07286	9.685464	3.135687
9	B_SMneg	p	2.081878	9.917585	3.645345	5.617526	13.85520	18.89059	15.62987	9.800390	4.111269
10	B_SMneg	s	1.290679	9.253460	4.551482	7.237275	13.42201	17.75711	15.62313	9.960167	1.944506
11	B_SMneg	sw	1.767178	9.052639	4.320087	6.820395	13.53572	18.26823	17.67565	11.496393	2.855412
12	B_SMneg	sb	1.789424	10.205572	5.017204	6.871255	13.16565	19.35829	16.83258	9.192755	3.570446

```
kable(fakesplit$C) %>% kable_styling(latex_options="scale_down")
```

	donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
13	C_SMneg	un	1.1524707	10.973830	4.438291	6.771326	12.66627	17.25749	16.87973	10.70705	2.390605
14	C_SMneg	w	3.3421694	9.710743	3.117895	7.331474	12.90123	18.93955	17.97817	11.42288	3.403175
15	C_SMneg	p	0.7192464	8.849250	5.596580	7.414849	12.65280	20.65463	15.61381	10.12832	3.757290
16	C_SMneg	s	3.0880224	8.777129	3.833406	5.815086	14.27348	20.33369	16.93344	12.98050	3.973700
17	C_SMneg	sw	4.3010122	9.961081	5.917031	8.047496	13.42607	19.57184	16.11159	10.48565	4.401490
18	C_SMneg	sb	0.0479729	10.179052	5.798959	7.893204	12.53142	20.39951	17.14733	11.25043	2.331744

```
kable(fakesplit$D) %>% kable_styling(latex_options="scale_down")
```

	donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
19	D_SMneg	un	2.8548216	9.211446	4.500456	8.809123	12.45664	18.35376	17.45584	12.072876	2.536111
20	D_SMneg	w	1.5382136	11.870062	4.504540	8.579923	13.28919	17.03881	17.23374	10.313330	4.622989
21	D_SMneg	p	3.3102810	8.965868	5.925581	5.509438	13.00377	18.83454	16.82980	10.080244	3.462704
22	D_SMneg	s	2.2786475	9.501402	3.219218	6.674602	11.42003	18.12531	18.46174	9.681653	2.980723
23	D_SMneg	sw	2.5012998	11.256317	5.978418	8.003214	14.09331	19.32220	16.95533	11.555914	4.452405
24	D_SMneg	sb	0.8668985	7.865543	4.709626	5.484749	12.51847	19.11042	17.94757	11.017534	3.064637

```
kable(fakesplit$E) %>% kable_styling(latex_options="scale_down")
```

	donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
25	E_SMpos	un	1.0202145	8.604847	5.856313	6.994272	9.842017	19.27939	15.91967	12.923399	4.045546
26	E_SMpos	w	2.6056434	10.523405	5.215451	7.517863	12.138169	19.77805	16.50091	9.982125	1.896272
27	E_SMpos	p	0.6013112	8.835214	3.123827	7.773491	12.553212	16.91905	17.31690	11.932169	1.935181
28	E_SMpos	s	0.8396565	10.372774	4.718849	8.367093	13.098592	18.64031	15.52159	10.545326	3.653813
29	E_SMpos	sw	2.7070334	7.668059	5.896147	8.430689	12.926019	20.08289	16.82656	10.154061	4.034930
30	E_SMpos	sb	1.3399961	10.432844	4.961254	5.959061	13.526673	18.13090	17.91539	11.140532	3.360530

```
kable(fakesplit$F) %>% kable_styling(latex_options="scale_down")
```

	donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
31	F_SMpos	un	1.1089689	10.152818	4.706963	6.057703	11.72207	19.42656	20.42190	11.43899	4.960241
32	F_SMpos	w	0.9314907	10.133401	5.130127	7.410813	12.97050	20.17940	19.18816	11.93667	2.741093
33	F_SMpos	p	1.2244452	10.119343	5.261671	8.986393	12.02225	16.79281	16.80626	10.53830	4.765674
34	F_SMpos	s	1.0071515	11.323089	5.141189	7.765670	12.91359	18.94957	16.63000	10.05446	2.938103
35	F_SMpos	sw	2.7758239	11.181101	4.379994	7.245393	12.32173	19.53432	16.72596	11.45760	5.574408
36	F_SMpos	sb	2.1131696	9.662969	5.608451	5.924690	13.38823	17.28363	16.69862	12.32928	3.198824

Create function for subtracting out unstimulated

```
subtractun<-function (datatable) {
  #Split datatable by donor
    y<- split(datatable, donor)
  #Write function that will select numeric columns of datatable
    numeric.only <- function(X,...){
      returnCols <- names(X)
      a<-sapply(X, is.numeric)
      print(returnCols[a == "TRUE"])
      }
  #Apply numeric.only function to datatable
    for (z in numeric.only(datatable)){
  #Subtract out unstim value from respective stim cytokine values
    newcolumn<-unlist(lapply(y,function(g)
      (g[,z]- as.matrix(subset(g[,z], g$stim=="un"))[1,1])
      ))
  #Create new datatable with unstim substractions applied to all donors
    datatable[,z] <- newcolumn}
    datatable
      }
```

Apply function for subtracting out unstimulated to data table of interest

```
#Apply subtractun function to datatable of interest
newfake<-subtractun(fakecombined)
```

```
## [1] "ifng" "tnfa" "IL4"  "IL5"  "IL10" "IL13" "IL17" "IL21" "IL22"
```

```
newfake[newfake<0] <- 0
library(knitr)
library(kableExtra)
kable(newfake) %>% kable_styling(latex_options="scale_down")
```

donor	stim	ifng	tnfa	IL4	IL5	IL10	IL13	IL17	IL21	IL22
A_SMpos	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
A_SMpos	w	0.7987711	0.0000000	0.2162587	0.0000000	0.0000000	1.2027079	0.0000000	0.0000000	0.7459840
A_SMpos	p	0.6488185	0.0000000	1.2417153	0.0000000	0.0000000	1.0966743	0.0000000	0.0000000	2.6757566
A_SMpos	s	0.8597262	0.0000000	0.6142839	0.0000000	0.0000000	1.2631596	0.0000000	0.0000000	1.2800192
A_SMpos	sw	0.0000000	0.0000000	0.0000000	0.0000000	0.2031433	0.1387021	0.0000000	0.0000000	2.1556205
A_SMpos	sb	0.1619532	0.0000000	1.6957644	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	1.4886896
B_SMneg	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
B_SMneg	w	0.0000000	1.5916426	2.1770097	0.2398872	2.2112327	0.7524942	0.0000000	0.0000000	0.6851865
B_SMneg	p	0.0000000	0.0000000	0.2717713	0.0000000	1.3432897	0.0415080	0.0000000	0.0000000	1.6607680
B_SMneg	s	0.0000000	0.0000000	1.1779091	1.1143224	0.9101061	0.0000000	0.0000000	0.0000000	0.0000000
B_SMneg	sw	0.0000000	0.0000000	0.9465139	0.6974422	1.0238152	0.0000000	0.0000000	0.0000000	0.4049105
B_SMneg	sb	0.0000000	0.2627911	1.6436309	0.7483023	0.6537419	0.5092160	0.0000000	0.0000000	1.1199448
C_SMneg	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
C_SMneg	w	2.1896986	0.0000000	0.0000000	0.5601483	0.2349652	1.6820606	1.0984395	0.7158292	1.0125700
C_SMneg	p	0.0000000	0.0000000	1.1582893	0.6435235	0.0000000	3.3971389	0.0000000	0.0000000	1.3666850
C_SMneg	s	1.9355517	0.0000000	0.0000000	0.0000000	1.6072157	3.0761977	0.0537066	2.2734452	1.5830950
C_SMneg	sw	3.1485415	0.0000000	1.4787395	1.2761707	0.7598024	2.3143450	0.0000000	0.0000000	2.0108850
C_SMneg	sb	0.0000000	0.0000000	1.3606673	1.1218783	0.0000000	3.1420114	0.2675998	0.5433744	0.0000000
D_SMneg	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
D_SMneg	w	0.0000000	2.6586156	0.0040839	0.0000000	0.8325541	0.0000000	0.0000000	0.0000000	2.0868781
D_SMneg	p	0.4554594	0.0000000	1.4251248	0.0000000	0.5471354	0.4807757	0.0000000	0.0000000	0.9265931
D_SMneg	s	0.0000000	0.2899556	0.0000000	0.0000000	0.0000000	0.0000000	1.0058939	0.0000000	0.4446118
D_SMneg	sw	0.0000000	2.0448709	1.4779624	0.0000000	1.6366723	0.9684406	0.0000000	0.0000000	1.9162941
D_SMneg	sb	0.0000000	0.0000000	0.2091702	0.0000000	0.0618276	0.7566571	0.4917233	0.0000000	0.5285260
E_SMpos	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
E_SMpos	w	1.5854290	1.9185578	0.0000000	0.5235910	2.2961516	0.4986578	0.5812425	0.0000000	0.0000000
E_SMpos	p	0.0000000	0.2303663	0.0000000	0.7792197	2.7111950	0.0000000	1.3972339	0.0000000	0.0000000
E_SMpos	s	0.0000000	1.7679266	0.0000000	1.3728212	3.2565748	0.0000000	0.0000000	0.0000000	0.0000000
E_SMpos	sw	1.6868189	0.0000000	0.0398342	1.4364175	3.0840018	0.8034970	0.9068929	0.0000000	0.0000000
E_SMpos	sb	0.3197817	1.8279965	0.0000000	0.0000000	3.6846561	0.0000000	1.9957186	0.0000000	0.0000000
F_SMpos	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
F_SMpos	w	0.0000000	0.0000000	0.4231641	1.3531098	1.2484315	0.7528357	0.0000000	0.4976855	0.0000000
F_SMpos	p	0.1154763	0.0000000	0.5547081	2.9286898	0.3001837	0.0000000	0.0000000	0.0000000	0.0000000
F_SMpos	s	0.0000000	1.1702714	0.4342262	1.7079669	1.1915223	0.0000000	0.0000000	0.0000000	0.0000000
F_SMpos	sw	1.6668550	1.0282835	0.0000000	1.1876900	0.5996586	0.1077567	0.0000000	0.0186123	0.6141674
F_SMpos	sb	1.0042008	0.0000000	0.9014879	0.0000000	1.6661609	0.0000000	0.0000000	0.8902977	0.0000000
G_SMneg	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
G_SMneg	w	0.0000000	1.0180018	0.0000000	0.5111085	0.0000000	0.6209440	1.2382035	2.7384097	2.1506144
G_SMneg	p	0.9840563	0.0000000	0.8686215	0.0000000	0.0000000	0.0000000	0.0000000	0.4000626	0.9374429
G_SMneg	s	0.0000000	1.4700864	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	2.1603370	0.0000000
G_SMneg	sw	0.0000000	1.7109669	0.0000000	0.3174640	0.0000000	1.2745325	1.4013587	0.6107807	0.1267294
G_SMneg	sb	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.1385090	0.0000000
H_SMneg	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
H_SMneg	w	0.0000000	0.0000000	0.9158813	0.0000000	0.4820019	0.0000000	3.2778017	0.2175704	0.0000000
H_SMneg	p	1.2974486	0.0000000	0.0000000	0.0000000	0.0000000	2.0742220	0.6234055	1.8550414	0.0000000
H_SMneg	s	0.0000000	0.0000000	2.2938257	0.0000000	0.0000000	0.7033676	3.1182998	0.9705205	0.0000000
H_SMneg	sw	0.0000000	0.0000000	0.0000000	0.3931927	0.0000000	1.3057110	0.0000000	1.6985946	0.0000000
H_SMneg	sb	0.6918676	0.0000000	0.0000000	0.0000000	0.5366331	2.3857717	0.0000000	1.9261236	0.0000000
I_SMneg	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
I_SMneg	w	0.0000000	0.0000000	0.0000000	0.0000000	1.5031184	0.0000000	0.0000000	0.0000000	1.3154723
I_SMneg	p	0.0000000	0.0000000	0.0000000	0.0000000	0.8372514	0.0000000	0.0000000	0.0000000	0.3642103
I_SMneg	s	0.0245222	0.2047580	0.0000000	0.0000000	0.9574966	0.0000000	0.0000000	0.0000000	0.0000000
I_SMneg	sw	0.0000000	0.0000000	0.0000000	0.1313396	1.5418396	0.0000000	0.0000000	0.0000000	0.1252846
I_SMneg	sb	0.0000000	0.0000000	0.0000000	0.0000000	1.4041719	0.0000000	0.0000000	0.0000000	0.0000000
J_SMpos	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
J_SMpos	w	0.0000000	0.0000000	0.1428944	0.0000000	1.2221010	0.7963566	0.0000000	0.1111190	0.0000000
J_SMpos	p	0.0000000	0.0000000	0.0000000	0.0000000	1.5398688	1.3303026	0.0000000	1.0122066	1.2824966
J_SMpos	s	0.0000000	0.0000000	0.4914361	0.2187193	2.0286197	1.5731304	0.0000000	0.0000000	0.9056141
J_SMpos	sw	0.9023317	0.0000000	0.1250958	0.3424081	0.4454346	0.4644138	0.0749572	0.4269950	1.2911208
J_SMpos	sb	0.2890807	0.1142729	0.3374608	0.0689239	1.5367769	2.4205989	0.0320243	0.0000000	0.7981457
K_SMpos	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
K_SMpos	w	1.4191889	0.0000000	1.4475308	0.8613095	0.0739095	0.0000000	0.0000000	1.2890314	0.3769211
K_SMpos	p	1.6042448	1.2335885	1.8080897	1.0466507	0.3819609	2.5723572	1.0848978	1.2629936	0.0000000
K_SMpos	s	1.6588071	0.6008710	0.0000000	0.8905406	0.0000000	0.0000000	0.0000000	3.0831155	0.0000000
K_SMpos	sw	0.5268918	0.5766979	0.1007610	1.1738357	1.1996855	0.4108473	1.5575089	0.1299404	0.0000000
K_SMpos	sb	1.7791542	0.9160689	0.0000000	0.5813353	0.4339152	1.6273688	0.0000000	2.9618596	0.0000000
L_SMpos	un	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L_SMpos	w	0.0000000	0.5641089	0.0000000	0.0536728	0.0000000	0.1416763	0.0000000	0.0000000	1.0443360
L_SMpos	p	0.0000000	0.0000000	0.0543607	1.7582621	0.1306822	0.0000000	0.0000000	0.0000000	0.5803553
L_SMpos	s	0.0000000	0.0000000	0.3832057	0.0000000	0.0000000	1.5623745	1.6353797	0.0000000	0.5485645
L_SMpos	sw	0.0000000	1.5006587	0.0000000	0.5105217	0.7074872	0.3165847	0.7496558	1.2110493	0.0000000
L_SMpos	sb	0.0295254	0.3387996	0.0000000	0.0000000	0.1127949	1.5192927	0.0000000	0.6342590	0.7275794

```
library(dplyr)
library(tidyr)
newfake<-newfake %>%
  separate(donor, c("donor", "Status"), "_")
```

Reshape data table so that each cytokine name is assigned to row entries instead of having its own column

I applied the gather function to make the data table format compatible for the next set of functions.

```
library(tidyr)
library(knitr)

gathereddata<-gather(newfake, "Cytokine", "Concentration", c("ifng", "tnfa", "IL4", "IL5", "IL10", "IL13

kable(gathereddata)
```

donor	Status	stim	Cytokine	Concentration
A	SMpos	un	ifng	0.0000000
A	SMpos	w	ifng	0.7987711
A	SMpos	p	ifng	0.6488185
A	SMpos	s	ifng	0.8597262
A	SMpos	sw	ifng	0.0000000
A	SMpos	sb	ifng	0.1619532
B	SMneg	un	ifng	0.0000000
B	SMneg	w	ifng	0.0000000
B	SMneg	p	ifng	0.0000000
B	SMneg	s	ifng	0.0000000
B	SMneg	sw	ifng	0.0000000
B	SMneg	sb	ifng	0.0000000
C	SMneg	un	ifng	0.0000000
C	SMneg	w	ifng	2.1896986
C	SMneg	p	ifng	0.0000000
C	SMneg	s	ifng	1.9355517
C	SMneg	sw	ifng	3.1485415
C	SMneg	sb	ifng	0.0000000
D	SMneg	un	ifng	0.0000000
D	SMneg	w	ifng	0.0000000
D	SMneg	p	ifng	0.4554594
D	SMneg	s	ifng	0.0000000
D	SMneg	sw	ifng	0.0000000
D	SMneg	sb	ifng	0.0000000
E	SMpos	un	ifng	0.0000000
E	SMpos	w	ifng	1.5854290
E	SMpos	p	ifng	0.0000000
E	SMpos	s	ifng	0.0000000
E	SMpos	sw	ifng	1.6868189
E	SMpos	sb	ifng	0.3197817
F	SMpos	un	ifng	0.0000000
F	SMpos	w	ifng	0.0000000
F	SMpos	p	ifng	0.1154763
F	SMpos	s	ifng	0.0000000
F	SMpos	sw	ifng	1.6668550
F	SMpos	sb	ifng	1.0042008
G	SMneg	un	ifng	0.0000000
G	SMneg	w	ifng	0.0000000
G	SMneg	p	ifng	0.9840563
G	SMneg	s	ifng	0.0000000
G	SMneg	sw	ifng	0.0000000
G	SMneg	sb	ifng	0.0000000
H	SMneg	un	ifng	0.0000000
H	SMneg	w	ifng	0.0000000
H	SMneg	p	ifng	1.2974486
H	SMneg	s	ifng	0.0000000
H	SMneg	sw	ifng	0.0000000
H	SMneg	sb	ifng	0.6918676
I	SMneg	un	ifng	0.0000000
I	SMneg	w	ifng	0.0000000
I	SMneg	p	ifng	0.0000000
I	SMneg	s	ifng	0.0245222
I	SMneg	sw	ifng	0.0000000
I	SMneg	sb	ifng	0.0000000
J	SMpos	un	ifng	0.0000000
J	SMpos	w	ifng	0.0000000
J	SMpos	p	ifng	0.0000000

Calcualte p values for comparisons between SMneg and SMpos for different cytokines for different treatments

```
#Function for Wilcox rank sum 2-sample test
##Subset data by condition
##Split subsetted data by cytokine
##Run Wilcox rank sum 2-sample test by Schisto status
library(knitr)
pvals<-function(data,column,condition){
SubsettedData<-subset(data, data[,column]== condition)
x<-split(data,list(data$Cytokine))
A<-lapply(x, function(g) wilcox.test(g$Concentration~g[,"Status"]))
pvalslist<-c(A$infg$p.value,A$tnfa$p.value,A$IL4$p.value,A$IL5$p.value,A$IL10$p.value,A$IL13$p.value,A$
Analytes<-c("ifng","tnfa","IL4","IL5", "IL10","IL13", "IL17", "IL21", "IL22")
Pvalues<-round(pvalslist, 4)
table<-(cbind(Analytes, Pvalues))
}

#Apply function to desired stim condition of gathered data table
WilcoxTestTable_WCL<-pvals(gathereddata,"stim","w")
kable(WilcoxTestTable_WCL)
```

Analytes	Pvalues
ifng	0.1354
tnfa	0.3796
IL4	0.0104
IL5	0.0142
IL10	0.4233
IL13	0.8984
IL17	0.173
IL21	0.4984
IL22	0.1354

```
#Future direction: Adjust the p values to account for multiple comparisons
##hochberg_adj_pvals<-round(p.adjust(pvalslist, method="hochberg"), 4)
```

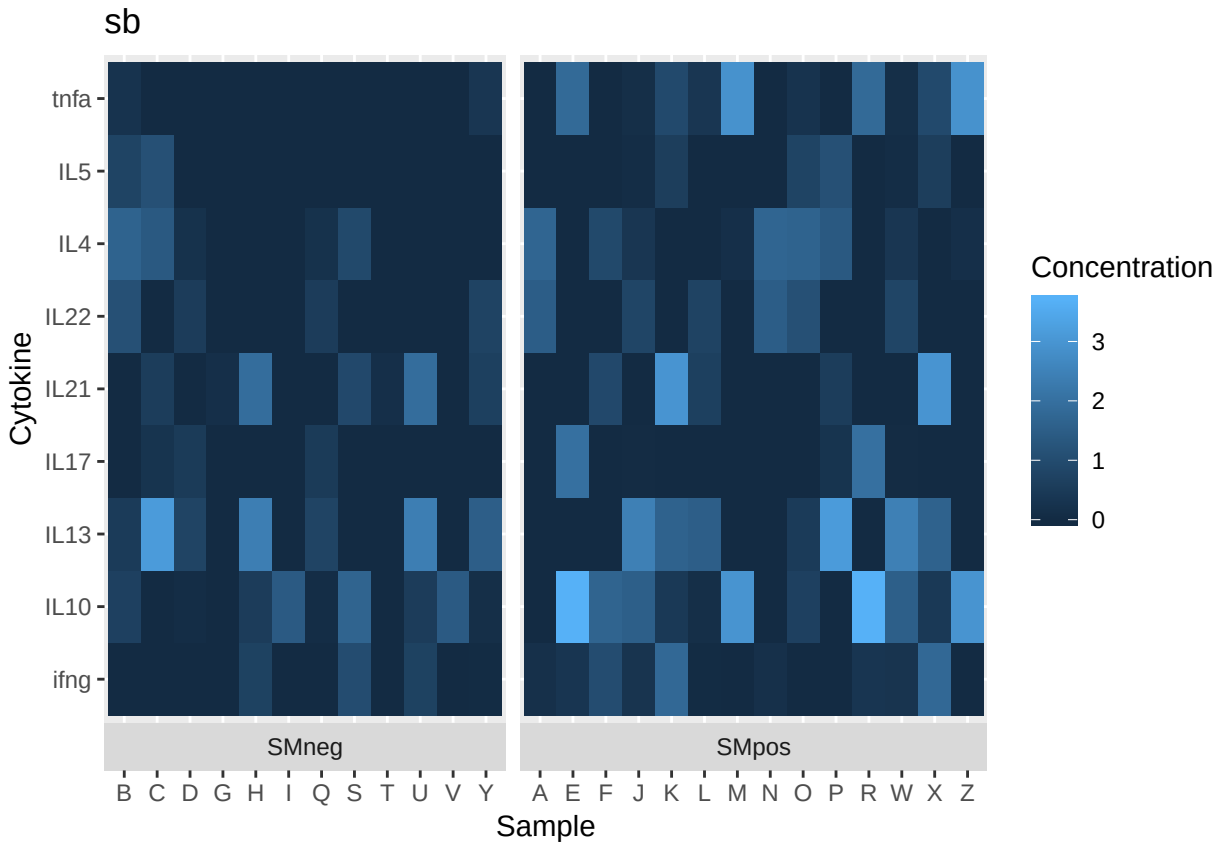
Perform Hierarchical Clustering Analysis

Generate Heatmap for each stim condition

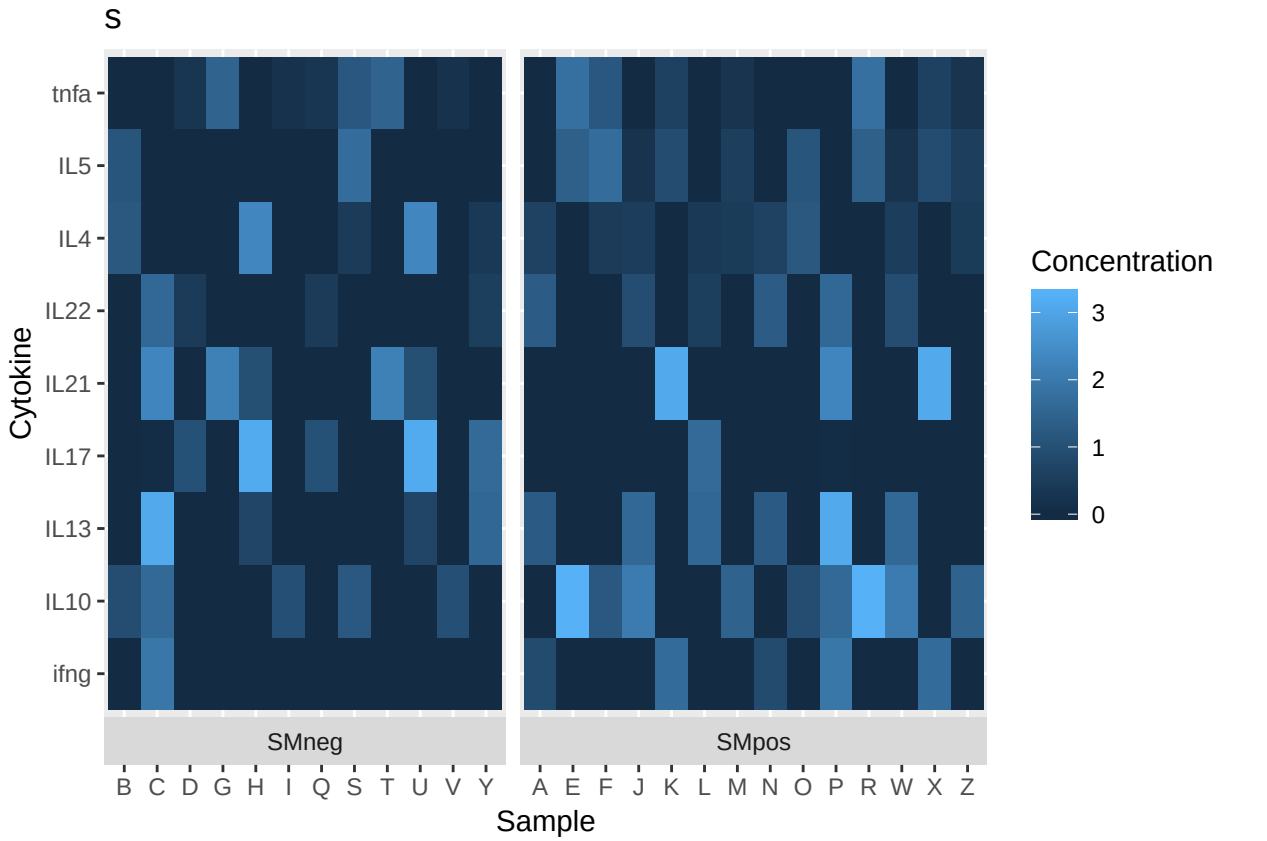
I created one heatmap per stim condition showing the differences in concentration of cytokines between patients.

```
library(ggplot2)
library(stats)

#Create general heatmap function
heatmapfunction<-function(data,column,condition){
SubsettedData<-subset(data, data[,column]== condition)
heatmap <- ggplot(data = SubsettedData, mapping = aes(x = donor,
              y = Cytokine,
              fill = Concentration)) +
```

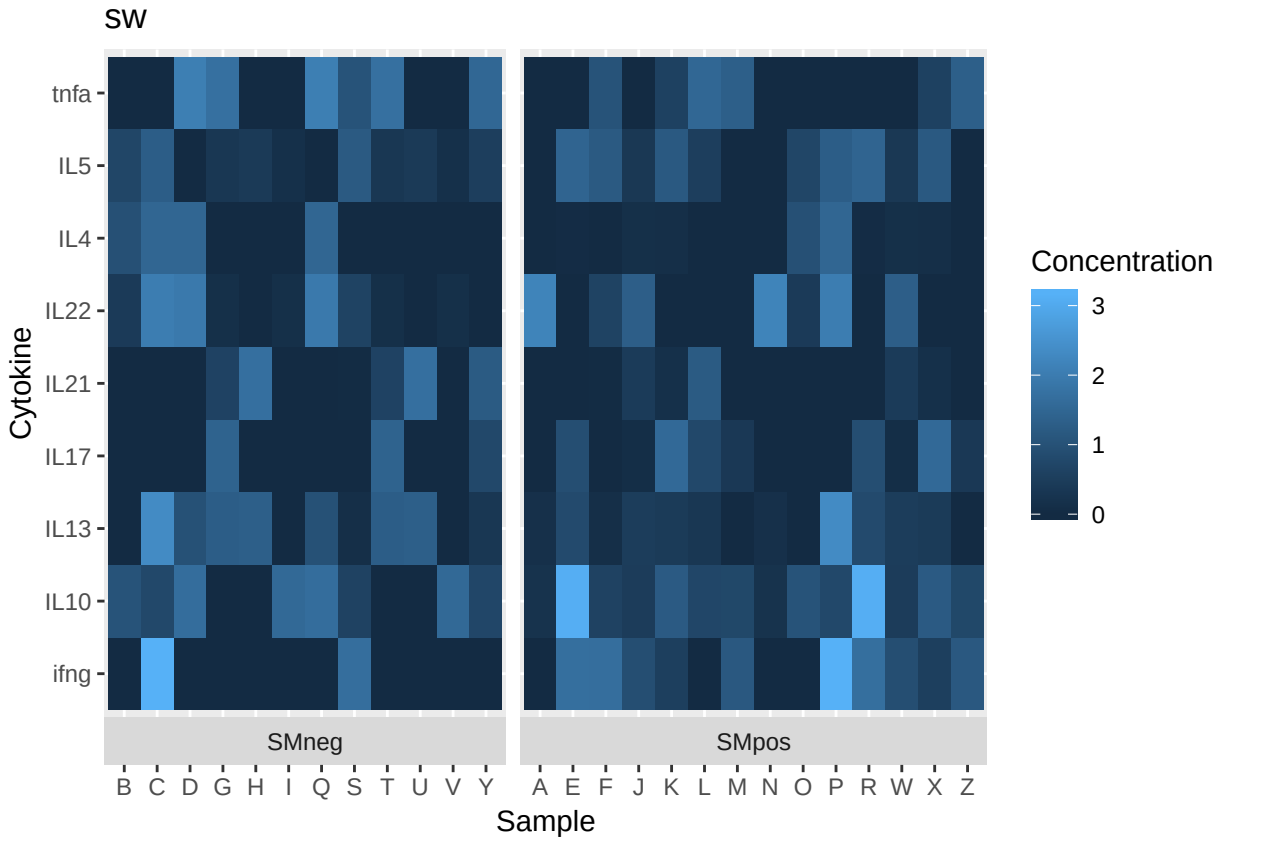
```
              geom_tile() +
              xlab(label = "Sample") +
              ggtitle(label = condition) +
              facet_grid(~Status, switch = "x", scales = "free_x", space = "free_x")
}
#Apply function to stimulation condition of interest in indicated datatable
SEB<-heatmapfunction(gathereddata,"stim","sb")
SEA<-heatmapfunction(gathereddata,"stim","s")
SWAP<-heatmapfunction(gathereddata,"stim","sw")
WCL<-heatmapfunction(gathereddata,"stim","w")
PeptidePool<-heatmapfunction(gathereddata,"stim","p")

SEB
```



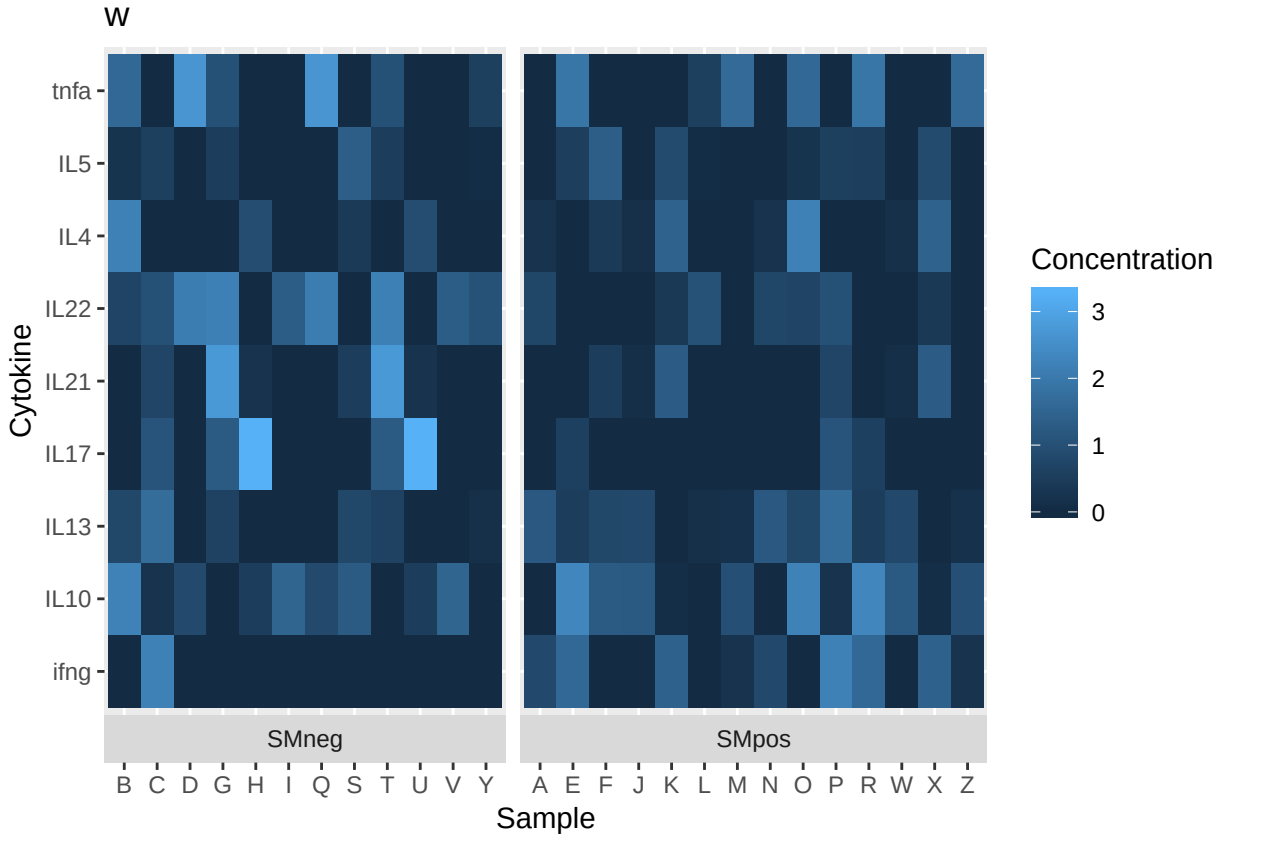

```
SEA
```


S
tnfa
IL5
IL4
IL22
IL21
IL17
IL13
IL10
ifng
Cytokine
SMneg
SMpos
B C D G H I Q S T U V Y
A E F J K L M N O P R W X Z
Sample
Concentration
3
2
1
0

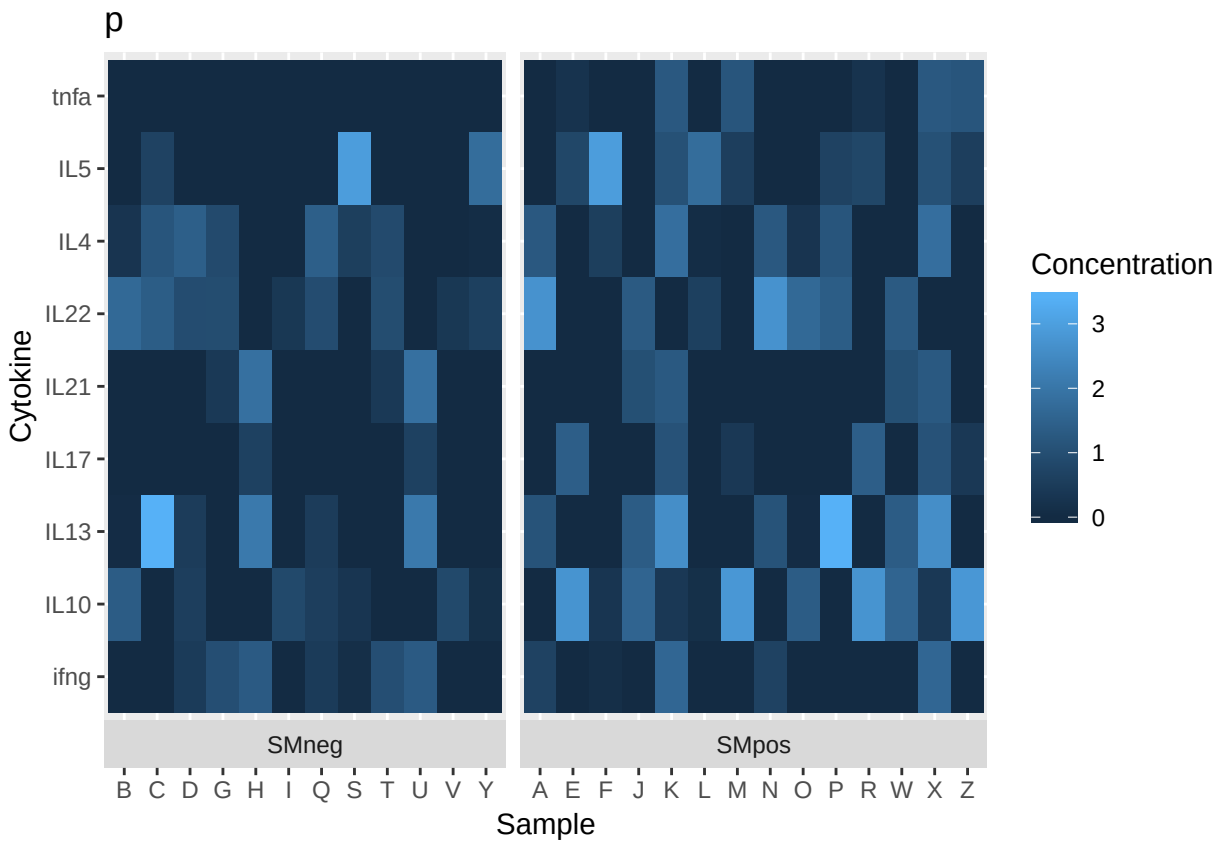
```
SWAP
```


SW
tnfa
IL5
IL4
IL22
IL21
IL17
IL13
IL10
ifng
Cytokine
SMneg
SMpos
B C D G H I Q S T U V Y
A E F J K L M N O P R W X Z
Sample
Concentration
3
2
1
0

```
WCL
```


W
tnfa
IL5
IL4
IL22
IL21
IL17
IL13
IL10
ifng
Cytokine
SMneg
SMpos
B C D G H I Q S T U V Y
A E F J K L M N O P R W X Z
Sample
Concentration
3
2
1
0

```
PeptidePool
```



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

Generate Dendrogram for each stim condition

Merge Heatmap and Dendrogram

Order heatmap according to position in dendrogram to generate hierarchically clustered heatmap