

Lab 7

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#Rcpp

We will get some experience with speeding up R code using C++ via the Rcpp package.

First, clear the workspace and load the Rcpp package.

```
pacman::p_load(Rcpp)
```

Create a variable `n` to be 10 and a variable `Nvec` to be 100 initially. Create a random vector via `rnorm` `Nvec` times and load it into a `Nvec` x `n` dimensional matrix.

```
n<- 10
Nvec <-100
X= matrix(data=rnorm(Nvec*n),nrow=Nvec)
head(X)
```

```
##           [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
## [1,] -0.4397502 -1.2204529 -0.7878354  0.3062626 -1.1524327 -1.2622356
## [2,] -1.2259186  0.6826253 -1.5219804 -1.6338564 -1.1202690  0.2387016
## [3,]  0.9164481  0.2821150  0.4424408 -1.3893161  1.6990418 -1.3271176
## [4,]  0.1248840  0.4388060  0.4511460  1.1829698 -1.0419700 -2.2440232
## [5,]  0.1350169 -0.8197670 -1.2730370 -0.6815183  1.2366778 -0.3339236
## [6,] -0.4290409 -0.1062662 -1.8324640  0.1514127  0.7083975 -0.4171737
##           [,7]      [,8]      [,9]      [,10]
## [1,] -1.1572211 -0.6723197  0.2392381 -1.1180142
## [2,]  2.2198021 -0.7231093 -0.1398713  0.4620570
## [3,]  0.3831768  1.3125005  0.2176839 -0.3677466
## [4,] -0.1186881 -1.8679005  0.5780430 -1.3159508
## [5,] -0.6183376 -0.9712476 -1.0924172 -0.9341088
## [6,]  0.7501025 -0.5611344 -1.8349142 -0.9311791
```

Write a function `all_angles` that measures the angle between each of the pairs of vectors. You should measure the vector on a scale of 0 to 180 degrees with negative angles coerced to be positive.

```
angle <- function(u,v){
  acos(sum(u*v)/sqrt(sum(u^2)*sum(v^2))) * 180/ pi
}

all_angles <- function(X){
  A <-matrix(NA, nrow = nrow(X), ncol = nrow(X))
  for(i in 1:(nrow(X)-1)){
    for(j in (i+1): nrow(X)) {
```

```

        A[i,j] = angle (X[i,],X[j,])
    }

    }
    A

}
all_angles(X)

```

##		[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]
##	[1,]	NA	96.56179	107.12503	52.75148	69.16655	79.42066	117.83027	126.02513
##	[2,]	NA	NA	99.14628	96.03559	90.48463	69.51862	113.75688	74.13108
##	[3,]	NA	NA	NA	99.45973	80.66848	91.15836	52.14025	71.49624
##	[4,]	NA	NA	NA	NA	88.75707	87.07345	107.82893	112.63684
##	[5,]	NA	NA	NA	NA	NA	43.23249	86.44075	116.51016
##	[6,]	NA	NA	NA	NA	NA	NA	91.44566	103.25357
##	[7,]	NA	NA	NA	NA	NA	NA	NA	68.17686
##	[8,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[9,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[10,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[11,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[12,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[13,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[14,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[15,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[16,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[17,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[18,]	NA	NA	NA	NA	NA	NA	NA	NA
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##	[23,]	NA	NA	NA	NA	NA	NA	NA	NA
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##	[26,]	NA	NA	NA	NA	NA	NA	NA	NA
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##	[32,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[33,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[34,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[35,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[36,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[37,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[38,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[39,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[40,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[41,]	NA	NA	NA	NA	NA	NA	NA	NA
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##	[77,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA	NA
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##	[94,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA	NA

##	[98,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA	NA
##		[,9]	[,10]	[,11]	[,12]	[,13]	[,14]	[,15]	
##	[1,]	114.38741	96.69839	79.46064	44.53381	79.30840	88.53449	88.23884	
##	[2,]	51.75116	66.34668	97.79277	97.37958	97.88385	73.83040	89.32786	
##	[3,]	75.65932	68.28223	111.14409	99.69000	75.29206	89.37606	80.82197	
##	[4,]	119.02831	90.79280	84.60206	74.62491	87.87831	45.98377	90.93492	
##	[5,]	68.81550	99.37686	85.59028	80.34553	60.39017	96.49195	112.69283	
##	[6,]	65.49370	75.73545	82.93332	75.33146	62.41450	91.99026	138.20069	
##	[7,]	71.05125	66.44491	90.39668	105.28625	76.10888	93.34745	100.89892	
##	[8,]	72.12639	53.67246	129.70355	104.35686	106.29889	92.00913	82.46890	
##	[9,]		NA	66.86052	93.65021	111.68061	78.83440	84.34194	99.09514
##	[10,]		NA	NA	104.47046	77.99502	78.34850	80.58582	103.53396
##	[11,]		NA	NA	NA	98.72740	98.70847	87.10584	95.11865
##	[12,]		NA	NA	NA	NA	57.56804	110.19454	108.38777
##	[13,]		NA	NA	NA	NA	NA	95.71633	128.14756
##	[14,]		NA	NA	NA	NA	NA	NA	84.62181
##	[15,]		NA	NA	NA	NA	NA	NA	NA
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##	[70,]	NA	NA	NA	NA	NA	NA	NA
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##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
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##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
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##	[92,]	NA	NA	NA	NA	NA	NA	NA
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##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,16]	[,17]	[,18]	[,19]	[,20]	[,21]	[,22]
##	[1,]	80.94852	87.30509	106.60964	79.03024	101.28957	94.74691	99.42676
##	[2,]	67.63232	83.15477	102.52317	85.14940	83.57338	97.23927	115.21611
##	[3,]	87.11264	44.56042	94.90850	114.50946	91.96654	57.42202	88.06682

##	[4,]	94.80617	83.66725	103.88428	78.51753	107.17183	91.83053	100.69465
##	[5,]	83.86337	76.81830	120.48496	74.74302	96.56804	42.48665	98.28450
##	[6,]	71.58747	76.40721	128.78498	85.43517	78.23985	58.16969	125.07181
##	[7,]	91.79071	69.03564	108.23811	107.73091	78.89054	52.89851	77.78654
##	[8,]	84.42068	96.75587	87.30575	109.62161	57.43085	90.44624	71.93876
##	[9,]	70.39911	72.15770	115.46840	89.78539	84.43081	59.48304	100.02332
##	[10,]	60.25142	62.19969	118.31482	121.80772	67.26261	78.46728	112.46804
##	[11,]	107.98877	78.77211	103.46360	63.01690	109.11117	95.73180	107.00701
##	[12,]	53.22849	91.37998	98.87524	115.45787	76.19373	97.64909	107.15481
##	[13,]	50.02079	72.41954	102.26285	126.94173	92.93226	58.78127	116.27361
##	[14,]	97.54438	75.76511	102.80580	77.65806	114.68166	82.00894	100.88411
##	[15,]	106.26570	86.70833	71.32891	73.91972	102.40484	115.80700	58.10514
##	[16,]	NA	78.98047	108.77899	123.54997	65.30720	90.36599	110.29965
##	[17,]	NA	NA	112.61874	104.12174	105.06116	66.40083	119.05914
##	[18,]	NA	NA	NA	104.58199	110.15078	118.64378	80.55041
##	[19,]	NA	NA	NA	NA	97.25933	93.05246	70.69150
##	[20,]	NA	NA	NA	NA	NA	98.01773	75.11878
##	[21,]	NA	NA	NA	NA	NA	NA	94.83267
##	[22,]	NA	NA	NA	NA	NA	NA	NA
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##	[63,]	NA	NA	NA	NA	NA	NA	NA
##	[64,]	NA	NA	NA	NA	NA	NA	NA
##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##	[,23]	[,24]	[,25]	[,26]	[,27]	[,28]	[,29]	
##	[1,]	79.46957	79.70811	89.66064	76.49590	118.74795	110.08233	96.85095
##	[2,]	78.12616	98.96537	111.66843	101.12122	95.36785	110.93278	72.56239
##	[3,]	72.16473	69.09832	94.43541	78.18700	65.83952	50.04137	52.49238
##	[4,]	77.71192	54.92371	85.70353	82.01891	107.30899	109.98459	81.96943
##	[5,]	67.12690	84.62673	105.94455	102.85904	105.79865	63.88707	97.63763
##	[6,]	48.26316	102.25357	117.77776	102.62644	107.72583	80.12998	91.15043
##	[7,]	79.54428	100.15744	84.84763	106.58401	68.46454	29.49748	72.22319
##	[8,]	77.99939	112.08269	74.93105	80.78893	51.40810	73.68436	51.22370
##	[9,]	80.94438	104.52744	111.57103	123.41929	82.87781	63.89195	73.02566
##	[10,]	56.84644	107.89335	102.49640	87.00255	72.82146	77.64704	39.49431

##	[11,]	96.04649	95.33321	102.85177	131.57985	137.47864	103.42458	132.19088
##	[12,]	78.09597	99.73962	92.55569	53.55697	92.02979	100.45432	83.69395
##	[13,]	87.47740	83.91303	115.87203	77.62408	72.84618	65.95885	75.59964
##	[14,]	87.64566	53.92721	97.02301	106.58423	92.80657	98.82369	68.90170
##	[15,]	109.72895	70.60308	63.73719	84.47231	94.56280	103.65810	86.67717
##	[16,]	83.21750	103.34460	97.47440	73.89420	80.61780	86.90395	65.32212
##	[17,]	68.40148	68.02301	115.20513	96.13416	96.45842	75.15862	64.60753
##	[18,]	134.88949	76.20932	92.27543	62.54200	63.51807	110.32047	100.27709
##	[19,]	85.44615	87.21763	72.30213	125.42100	136.80053	101.98738	125.35658
##	[20,]	62.12757	133.89525	58.28548	80.52223	88.16861	78.85365	82.43825
##	[21,]	66.73439	81.58343	108.29084	107.20844	77.93640	35.48723	73.25245
##	[22,]	103.17524	93.98652	31.64271	88.63858	81.94497	71.78746	97.18753
##	[23,]	NA	100.63463	89.73983	89.33957	104.26651	76.64011	70.43258
##	[24,]	NA	NA	97.26833	78.00769	87.68457	95.18900	78.67668
##	[25,]	NA	NA	NA	81.51398	95.42224	84.48335	95.62522
##	[26,]	NA	NA	NA	NA	63.90314	101.12420	69.20998
##	[27,]	NA	NA	NA	NA	NA	66.74339	52.55865
##	[28,]	NA	NA	NA	NA	NA	NA	73.08747
##	[29,]	NA	NA	NA	NA	NA	NA	NA
##	[30,]	NA	NA	NA	NA	NA	NA	NA
##	[31,]	NA	NA	NA	NA	NA	NA	NA
##	[32,]	NA	NA	NA	NA	NA	NA	NA
##	[33,]	NA	NA	NA	NA	NA	NA	NA
##	[34,]	NA	NA	NA	NA	NA	NA	NA
##	[35,]	NA	NA	NA	NA	NA	NA	NA
##	[36,]	NA	NA	NA	NA	NA	NA	NA
##	[37,]	NA	NA	NA	NA	NA	NA	NA
##	[38,]	NA	NA	NA	NA	NA	NA	NA
##	[39,]	NA	NA	NA	NA	NA	NA	NA
##	[40,]	NA	NA	NA	NA	NA	NA	NA
##	[41,]	NA	NA	NA	NA	NA	NA	NA
##	[42,]	NA	NA	NA	NA	NA	NA	NA
##	[43,]	NA	NA	NA	NA	NA	NA	NA
##	[44,]	NA	NA	NA	NA	NA	NA	NA
##	[45,]	NA	NA	NA	NA	NA	NA	NA
##	[46,]	NA	NA	NA	NA	NA	NA	NA
##	[47,]	NA	NA	NA	NA	NA	NA	NA
##	[48,]	NA	NA	NA	NA	NA	NA	NA
##	[49,]	NA	NA	NA	NA	NA	NA	NA
##	[50,]	NA	NA	NA	NA	NA	NA	NA
##	[51,]	NA	NA	NA	NA	NA	NA	NA
##	[52,]	NA	NA	NA	NA	NA	NA	NA
##	[53,]	NA	NA	NA	NA	NA	NA	NA
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##	[60,]	NA	NA	NA	NA	NA	NA	NA
##	[61,]	NA	NA	NA	NA	NA	NA	NA
##	[62,]	NA	NA	NA	NA	NA	NA	NA
##	[63,]	NA	NA	NA	NA	NA	NA	NA
##	[64,]	NA	NA	NA	NA	NA	NA	NA

##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
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##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,30]	[,31]	[,32]	[,33]	[,34]	[,35]	[,36]
##	[1,]	101.52830	126.51667	90.52825	89.48815	136.41343	71.52288	70.12082
##	[2,]	107.41377	58.99873	137.61096	71.18133	79.50652	99.86006	63.98305
##	[3,]	92.29456	91.91373	81.85451	79.44649	96.01888	104.79706	84.24594
##	[4,]	74.05831	101.72937	91.10436	93.88481	118.72418	90.39589	70.80893
##	[5,]	101.25311	84.72074	103.11881	91.33340	87.48304	81.49006	73.55806
##	[6,]	84.02548	77.98529	104.15450	77.33446	89.00321	84.84872	90.64308
##	[7,]	76.58885	83.57435	81.71498	94.66903	76.97500	99.18600	111.24844
##	[8,]	103.33691	63.38265	92.07202	83.68549	71.89195	120.70784	108.32120
##	[9,]	106.81479	48.95785	137.17743	85.72637	59.29941	100.75647	72.43015
##	[10,]	92.46747	84.79445	101.85581	72.38236	104.88450	109.29534	96.60495
##	[11,]	59.56893	105.72000	92.09677	73.86290	90.40928	60.11985	86.90511
##	[12,]	100.30212	130.70753	77.04062	100.17140	142.99273	76.25227	99.89355
##	[13,]	94.32351	99.45002	90.94471	116.78126	109.63591	91.23752	92.15601
##	[14,]	78.95252	66.52967	117.03434	91.45745	87.04347	109.97374	57.06380
##	[15,]	105.47741	99.09334	96.84918	83.36226	92.09655	83.75816	61.18744
##	[16,]	100.38991	96.48804	113.42496	111.22131	110.32125	78.33899	87.45942
##	[17,]	80.87088	102.76173	98.92672	65.12766	111.83326	88.66567	66.90333

##	[18,]	102.09728	95.72945	61.02625	96.54441	87.22015	106.88184	97.98982
##	[19,]	81.69354	76.03894	107.87811	79.29994	65.22837	69.32186	70.17466
##	[20,]	79.79075	86.54460	88.83743	95.26058	82.84517	72.62194	125.98893
##	[21,]	95.91389	70.10752	97.52230	91.80748	78.19214	108.84621	83.85563
##	[22,]	98.01533	84.30821	83.23442	111.73997	67.27488	83.62326	97.51836
##	[23,]	79.12108	87.67904	91.00683	59.88400	99.63958	88.97505	96.56543
##	[24,]	87.76921	94.14279	89.71220	95.70838	103.39134	100.35686	52.18437
##	[25,]	79.54047	96.27783	82.49830	110.50501	82.41451	66.96491	103.71171
##	[26,]	104.45700	117.10882	58.73703	98.03681	126.01865	98.22111	101.39085
##	[27,]	113.66887	74.16131	77.44705	108.60448	84.16016	137.28975	104.97998
##	[28,]	91.96554	76.48372	88.25831	103.83785	72.15596	99.19216	101.82101
##	[29,]	107.96616	78.91360	101.51517	87.90086	104.44651	125.32563	79.60606
##	[30,]	NA	98.24388	75.20039	88.18837	86.88443	64.23721	112.44200
##	[31,]	NA	NA	122.05476	93.76293	34.37097	119.64902	82.10976
##	[32,]	NA	NA	NA	83.72513	107.26053	93.43394	131.86087
##	[33,]	NA	NA	NA	NA	96.80864	97.92634	85.46845
##	[34,]	NA	NA	NA	NA	NA	98.72600	95.61256
##	[35,]	NA	NA	NA	NA	NA	NA	91.83320
##	[36,]	NA	NA	NA	NA	NA	NA	NA
##	[37,]	NA	NA	NA	NA	NA	NA	NA
##	[38,]	NA	NA	NA	NA	NA	NA	NA
##	[39,]	NA	NA	NA	NA	NA	NA	NA
##	[40,]	NA	NA	NA	NA	NA	NA	NA
##	[41,]	NA	NA	NA	NA	NA	NA	NA
##	[42,]	NA	NA	NA	NA	NA	NA	NA
##	[43,]	NA	NA	NA	NA	NA	NA	NA
##	[44,]	NA	NA	NA	NA	NA	NA	NA
##	[45,]	NA	NA	NA	NA	NA	NA	NA
##	[46,]	NA	NA	NA	NA	NA	NA	NA
##	[47,]	NA	NA	NA	NA	NA	NA	NA
##	[48,]	NA	NA	NA	NA	NA	NA	NA
##	[49,]	NA	NA	NA	NA	NA	NA	NA
##	[50,]	NA	NA	NA	NA	NA	NA	NA
##	[51,]	NA	NA	NA	NA	NA	NA	NA
##	[52,]	NA	NA	NA	NA	NA	NA	NA
##	[53,]	NA	NA	NA	NA	NA	NA	NA
##	[54,]	NA	NA	NA	NA	NA	NA	NA
##	[55,]	NA	NA	NA	NA	NA	NA	NA
##	[56,]	NA	NA	NA	NA	NA	NA	NA
##	[57,]	NA	NA	NA	NA	NA	NA	NA
##	[58,]	NA	NA	NA	NA	NA	NA	NA
##	[59,]	NA	NA	NA	NA	NA	NA	NA
##	[60,]	NA	NA	NA	NA	NA	NA	NA
##	[61,]	NA	NA	NA	NA	NA	NA	NA
##	[62,]	NA	NA	NA	NA	NA	NA	NA
##	[63,]	NA	NA	NA	NA	NA	NA	NA
##	[64,]	NA	NA	NA	NA	NA	NA	NA
##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA

##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,37]	[,38]	[,39]	[,40]	[,41]	[,42]	[,43]
##	[1,]	86.83001	60.27380	113.43141	93.44940	117.27758	73.31728	82.28887
##	[2,]	66.06522	96.34874	69.82906	86.01131	122.72439	94.43496	111.09647
##	[3,]	111.10101	118.83873	70.34129	62.30833	75.90057	88.97174	81.84948
##	[4,]	106.18559	73.75324	99.29642	68.20879	101.11345	91.68478	90.25417
##	[5,]	82.98351	109.62814	127.43939	89.91879	85.94379	98.96144	72.09564
##	[6,]	67.27255	94.71505	109.49412	69.75998	88.50524	123.46058	108.05610
##	[7,]	113.33327	111.56248	84.70481	73.40205	64.22139	91.03551	72.02184
##	[8,]	74.95273	117.50585	60.71483	70.11323	104.22019	103.58670	90.20607
##	[9,]	82.35569	122.32177	80.29229	91.95726	97.58007	89.05590	83.72934
##	[10,]	83.49103	90.46453	56.34596	50.75135	110.24218	97.55170	107.45783
##	[11,]	119.61766	55.08898	112.25347	103.58074	65.63593	73.85115	92.62848
##	[12,]	62.11571	58.44995	89.71420	87.06907	116.93711	89.16946	106.46703
##	[13,]	78.92213	92.18248	81.62034	84.88933	88.25378	96.21628	99.43052
##	[14,]	116.58777	98.67899	80.60456	69.26787	96.60158	88.89020	85.22577
##	[15,]	111.55821	91.55070	81.04690	110.03244	105.48333	46.40917	66.27680
##	[16,]	57.35861	81.13150	63.27877	93.90198	124.13438	83.68537	113.31295
##	[17,]	120.82515	88.74499	71.80071	64.19397	81.89762	76.70714	96.97466
##	[18,]	89.72322	89.32411	71.14247	106.58670	76.83071	88.53268	96.53181
##	[19,]	100.90191	92.94297	138.16778	106.90797	87.63018	84.49814	65.84029
##	[20,]	52.45236	90.23130	89.40968	84.29954	105.04523	108.80586	105.40834
##	[21,]	100.36993	129.58202	105.26002	68.27731	73.26688	105.46965	66.13119
##	[22,]	93.55428	112.29485	108.00658	112.53392	92.19783	76.10382	46.49574
##	[23,]	79.84835	95.82853	103.11602	43.74330	96.17732	119.36667	99.90525
##	[24,]	122.33097	100.03212	84.38134	81.06023	81.60521	80.41033	80.83641

##	[25,]	87.92776	92.28744	104.90383	103.68300	100.04965	79.97344	69.15654
##	[26,]	67.69019	83.47079	69.45064	78.66082	105.62151	98.58628	107.29728
##	[27,]	80.69152	120.85924	53.89686	77.80221	90.44028	101.77780	86.94488
##	[28,]	99.09783	130.02575	97.00093	80.23211	71.32353	95.78753	61.35588
##	[29,]	87.92845	112.14496	49.56773	53.22807	114.88844	93.32916	91.97737
##	[30,]	110.99265	68.86944	96.77655	76.14148	54.79761	104.49052	113.38845
##	[31,]	79.99478	137.39647	88.37034	84.66044	90.12324	113.45043	81.66603
##	[32,]	96.09658	76.66392	95.11654	75.87919	58.05202	108.02807	98.11497
##	[33,]	100.76261	81.71091	90.36596	61.63673	83.50897	98.76557	103.16225
##	[34,]	87.19972	128.78625	101.88049	104.02461	71.28301	105.00050	74.91254
##	[35,]	88.65518	57.77223	112.10473	119.76928	89.31535	69.14778	96.63732
##	[36,]	106.92999	99.15029	88.10250	99.75864	112.78351	59.04221	71.93224
##	[37,]	NA	92.61944	89.13896	96.77805	119.48282	115.02453	111.48078
##	[38,]	NA	NA	87.87087	98.58768	95.37537	73.51741	118.57988
##	[39,]	NA	NA	NA	78.52892	102.34675	82.15619	117.50020
##	[40,]	NA	NA	NA	NA	83.01327	126.19810	106.70608
##	[41,]	NA	NA	NA	NA	NA	107.70790	92.30400
##	[42,]	NA	NA	NA	NA	NA	NA	65.35323
##	[43,]	NA	NA	NA	NA	NA	NA	NA
##	[44,]	NA	NA	NA	NA	NA	NA	NA
##	[45,]	NA	NA	NA	NA	NA	NA	NA
##	[46,]	NA	NA	NA	NA	NA	NA	NA
##	[47,]	NA	NA	NA	NA	NA	NA	NA
##	[48,]	NA	NA	NA	NA	NA	NA	NA
##	[49,]	NA	NA	NA	NA	NA	NA	NA
##	[50,]	NA	NA	NA	NA	NA	NA	NA
##	[51,]	NA	NA	NA	NA	NA	NA	NA
##	[52,]	NA	NA	NA	NA	NA	NA	NA
##	[53,]	NA	NA	NA	NA	NA	NA	NA
##	[54,]	NA	NA	NA	NA	NA	NA	NA
##	[55,]	NA	NA	NA	NA	NA	NA	NA
##	[56,]	NA	NA	NA	NA	NA	NA	NA
##	[57,]	NA	NA	NA	NA	NA	NA	NA
##	[58,]	NA	NA	NA	NA	NA	NA	NA
##	[59,]	NA	NA	NA	NA	NA	NA	NA
##	[60,]	NA	NA	NA	NA	NA	NA	NA
##	[61,]	NA	NA	NA	NA	NA	NA	NA
##	[62,]	NA	NA	NA	NA	NA	NA	NA
##	[63,]	NA	NA	NA	NA	NA	NA	NA
##	[64,]	NA	NA	NA	NA	NA	NA	NA
##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA

##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,44]	[,45]	[,46]	[,47]	[,48]	[,49]	[,50]
##	[1,]	120.09763	67.30646	85.52510	79.51065	124.20320	96.54632	111.54946
##	[2,]	95.86091	99.87846	69.81575	117.00264	76.75111	112.04217	92.38487
##	[3,]	88.15372	78.87368	116.98854	105.89708	51.41188	94.05200	54.67251
##	[4,]	116.02938	54.14221	85.19226	90.35603	104.11989	104.99268	117.70717
##	[5,]	120.09589	91.55685	111.18743	111.51114	100.02888	80.59402	72.81731
##	[6,]	120.45998	94.73825	111.78654	107.94764	89.29290	85.62189	74.80864
##	[7,]	96.41688	81.22321	129.10204	101.22216	68.95925	70.49787	69.52685
##	[8,]	91.07451	98.03564	82.49098	107.73481	50.04856	120.10973	72.64323
##	[9,]	100.95281	100.97432	99.77071	133.27539	69.57167	85.90021	75.89789
##	[10,]	114.86351	76.18715	103.61659	106.56962	57.81916	107.11549	82.50706
##	[11,]	78.33002	89.88923	97.27179	63.28976	136.45685	47.94902	100.25305
##	[12,]	115.99169	71.50768	101.56866	79.64330	93.45146	94.17978	106.50149
##	[13,]	114.70209	77.45757	126.45117	105.42356	68.94715	74.81958	93.13296
##	[14,]	106.58994	67.95553	78.81179	111.90287	85.87408	106.14379	109.82750
##	[15,]	63.50280	80.46189	65.94144	87.28770	97.04164	101.15221	96.98961
##	[16,]	106.47855	66.55359	114.13181	117.59144	62.27102	85.52753	111.59793
##	[17,]	92.72105	69.05768	117.33555	98.55582	74.74334	81.08324	73.98122
##	[18,]	50.73786	119.71517	58.48167	59.94153	84.07646	100.19124	84.82080
##	[19,]	87.98233	92.84086	73.96531	92.82925	134.91587	84.46015	95.79683
##	[20,]	94.06915	79.47520	111.52854	104.91534	72.49495	89.27204	90.79799
##	[21,]	123.59033	90.79736	117.42889	118.08480	76.69749	86.76514	60.77771
##	[22,]	80.49419	84.90313	85.14980	97.45953	95.31428	91.60248	92.85861
##	[23,]	120.15095	77.49302	109.99651	104.40239	82.59107	104.86971	66.81679
##	[24,]	86.18393	72.35212	84.78470	95.67156	84.49674	99.68121	94.09598
##	[25,]	82.17536	64.21193	95.16124	96.30292	95.41903	88.62001	107.99986
##	[26,]	88.01572	83.41932	85.12151	78.69074	66.60947	117.37673	88.21244
##	[27,]	93.30027	103.26512	85.84989	99.98349	41.49348	113.07509	75.12150
##	[28,]	106.05997	85.17692	129.16911	116.26018	67.26463	76.40462	64.17257
##	[29,]	113.89262	71.78336	94.12302	119.88007	40.32872	125.58662	82.38892
##	[30,]	72.98374	69.24441	120.03335	78.49575	95.37149	56.92377	99.51859
##	[31,]	97.97298	111.16431	76.45867	128.53043	71.04362	105.84639	79.74150

##	[32,]	74.62285	101.31499	94.23969	42.31873	92.65927	88.76651	68.98669
##	[33,]	84.07596	109.68003	75.25412	69.02546	99.94944	105.70791	53.82685
##	[34,]	76.07112	117.55724	83.86500	111.05404	85.46052	82.40674	77.21337
##	[35,]	72.88974	64.65236	116.77773	84.28466	116.32401	46.31778	113.81682
##	[36,]	97.64562	77.56429	73.09466	113.29623	97.45443	101.58991	101.56180
##	[37,]	102.00872	104.78354	83.85094	102.80392	76.93484	106.81513	92.27985
##	[38,]	80.07604	75.32024	90.54391	49.78470	119.44590	71.28157	119.51361
##	[39,]	75.33473	85.35602	86.71870	95.38459	43.68283	103.19756	94.41040
##	[40,]	113.14686	83.45882	98.29755	92.67382	66.20856	117.63937	63.91198
##	[41,]	64.33241	107.53742	109.22557	67.40804	93.42301	58.80760	63.11303
##	[42,]	78.29193	68.60016	86.96035	87.75162	107.37940	73.35331	116.08104
##	[43,]	105.51211	87.06700	83.93893	102.72008	107.60046	92.04940	86.73559
##	[44,]	NA	104.52534	84.49069	66.55970	88.66447	69.24598	85.61651
##	[45,]	NA	NA	120.50399	109.44049	85.38905	79.73483	125.69429
##	[46,]	NA	NA	NA	74.63498	105.85738	130.12931	92.10181
##	[47,]	NA	NA	NA	NA	119.72721	82.19318	83.49034
##	[48,]	NA	NA	NA	NA	NA	105.92069	75.75139
##	[49,]	NA	NA	NA	NA	NA	NA	101.99629
##	[50,]	NA	NA	NA	NA	NA	NA	NA
##	[51,]	NA	NA	NA	NA	NA	NA	NA
##	[52,]	NA	NA	NA	NA	NA	NA	NA
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##	[62,]	NA	NA	NA	NA	NA	NA	NA
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##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA

##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,51]	[,52]	[,53]	[,54]	[,55]	[,56]	[,57]
##	[1,]	98.24201	94.20818	112.51412	71.67135	86.87771	73.83641	104.04257
##	[2,]	85.63434	85.46245	88.02932	104.46487	51.68202	106.49556	135.18801
##	[3,]	99.51027	101.33912	99.53617	114.29928	106.12026	113.26801	68.40493
##	[4,]	113.75515	120.20880	112.04741	63.92521	95.48954	62.39104	104.82533
##	[5,]	92.94203	108.24489	82.81770	87.74645	93.43943	79.58669	99.05202
##	[6,]	100.89876	128.14179	73.85356	74.33556	80.56706	80.52065	111.20172
##	[7,]	92.62550	95.62656	58.57487	107.33745	111.41010	82.67364	38.36536
##	[8,]	67.58207	76.02913	88.93032	134.34245	104.51996	92.18416	88.20966
##	[9,]	85.60231	82.99394	59.29382	120.61723	67.21317	99.71872	95.37729
##	[10,]	100.90483	101.57218	82.57728	107.82591	80.51339	90.24662	85.64650
##	[11,]	93.43523	92.73039	55.04679	46.97059	70.11522	92.23682	79.35058
##	[12,]	110.46269	99.54907	111.94296	80.20915	87.92947	78.74040	90.46053
##	[13,]	138.65361	116.72012	91.24494	87.41957	79.79660	80.82207	72.79819
##	[14,]	110.27903	109.96951	93.56812	84.56382	79.60868	73.34463	104.81376
##	[15,]	64.99669	47.00325	110.88638	113.99435	95.07271	117.10845	92.27649
##	[16,]	116.35357	91.98778	91.74469	107.36590	70.97211	95.58698	89.97749
##	[17,]	115.63954	109.58263	88.64091	88.71599	75.62472	117.75162	78.45903
##	[18,]	89.79549	73.22063	119.47685	88.03474	86.03662	108.45701	88.50782
##	[19,]	55.13776	80.19405	74.81421	78.76686	98.56365	80.74589	113.98583
##	[20,]	69.31861	86.93386	75.62962	108.63206	115.25978	85.56812	88.63679
##	[21,]	100.10834	115.23235	74.86720	99.98479	100.63797	72.73160	78.01735
##	[22,]	49.36337	54.99854	90.42183	121.18332	135.77716	79.33442	75.60395
##	[23,]	82.70821	121.75972	85.90370	88.30877	108.03612	83.00307	105.56865
##	[24,]	117.18642	108.08555	124.49721	81.92195	90.50011	97.12325	95.99499
##	[25,]	58.97768	68.20665	91.64775	108.58483	139.21585	78.43562	79.95301
##	[26,]	102.00147	95.28307	147.45483	96.36772	104.71196	98.28395	94.44577
##	[27,]	100.91258	87.20222	106.33319	122.25011	96.31521	86.23413	73.33161
##	[28,]	88.76833	95.79920	68.21299	117.17620	117.38056	79.17510	54.30000
##	[29,]	105.43447	99.10667	109.76020	124.95089	90.89125	91.08966	90.18871
##	[30,]	104.44053	121.34967	65.98242	52.54761	102.98139	87.48764	73.64050
##	[31,]	76.64005	91.51661	71.49275	111.90709	85.95158	78.27748	110.77772
##	[32,]	91.14435	102.88463	106.75006	67.63473	118.84173	88.84696	67.24983
##	[33,]	72.14597	96.41101	89.75740	77.27395	78.91211	114.44048	108.99446
##	[34,]	61.99041	78.28462	56.91863	106.05805	96.80495	85.80895	93.86942
##	[35,]	85.07875	81.72929	74.25237	74.11426	95.13610	102.53799	82.73477
##	[36,]	96.54062	81.03565	106.16874	100.20487	64.72888	103.20113	115.07130
##	[37,]	80.19973	86.56591	98.27720	103.06150	87.81913	84.47800	117.68494
##	[38,]	104.43365	90.35294	90.29912	50.61726	71.12084	95.34356	85.56814

##	[39,]	114.86988	85.71321	104.26488	108.99112	65.58376	116.62296	82.58444
##	[40,]	103.76664	135.83165	99.38942	82.18741	101.65861	81.30057	95.80804
##	[41,]	97.49456	112.12422	69.77100	61.70722	102.10608	95.51769	62.55741
##	[42,]	88.34119	47.30418	90.60510	104.82032	74.65404	107.33910	71.76449
##	[43,]	64.96312	63.85726	85.65634	115.56733	112.80139	69.69265	75.95796
##	[44,]	80.93101	70.53033	89.57350	84.32913	86.05049	135.67381	80.68636
##	[45,]	111.02921	99.95818	94.54051	92.56782	104.26152	81.29947	76.07575
##	[46,]	68.09450	66.59920	114.10541	92.16267	73.51950	89.42954	125.87620
##	[47,]	87.75358	87.22024	97.61620	51.50515	86.90232	97.49363	78.37361
##	[48,]	108.48638	102.16663	101.40699	122.24631	93.52801	104.23259	83.58947
##	[49,]	101.88368	89.38069	49.57124	70.44162	85.91130	97.77174	53.63658
##	[50,]	72.95471	100.20631	90.25209	97.28673	101.98519	107.53160	89.73260
##	[51,]	NA	53.41756	80.58091	111.74551	112.62229	92.15302	102.59432
##	[52,]	NA	NA	87.38314	123.96301	84.94575	105.00929	84.21974
##	[53,]	NA	NA	NA	85.43166	84.41934	80.53662	68.80198
##	[54,]	NA	NA	NA	NA	79.43127	82.26708	93.63485
##	[55,]	NA	NA	NA	NA	NA	109.25716	105.39644
##	[56,]	NA	NA	NA	NA	NA	NA	87.35506
##	[57,]	NA	NA	NA	NA	NA	NA	NA
##	[58,]	NA	NA	NA	NA	NA	NA	NA
##	[59,]	NA	NA	NA	NA	NA	NA	NA
##	[60,]	NA	NA	NA	NA	NA	NA	NA
##	[61,]	NA	NA	NA	NA	NA	NA	NA
##	[62,]	NA	NA	NA	NA	NA	NA	NA
##	[63,]	NA	NA	NA	NA	NA	NA	NA
##	[64,]	NA	NA	NA	NA	NA	NA	NA
##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA

##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,58]	[,59]	[,60]	[,61]	[,62]	[,63]	[,64]
##	[1,]	110.29907	87.53318	83.63194	42.75549	110.70124	105.97863	86.34067
##	[2,]	98.54859	98.67991	96.16507	107.06038	97.89905	87.61807	81.54593
##	[3,]	103.86417	117.45578	53.63770	91.01282	58.69584	78.72429	64.46011
##	[4,]	91.10637	61.60425	90.34401	57.08127	85.62318	102.86927	92.28120
##	[5,]	91.63335	116.24670	103.59274	81.43328	108.22978	130.32073	99.37946
##	[6,]	81.34537	98.89964	99.54780	86.46186	100.44470	133.71748	104.15396
##	[7,]	79.09836	101.29904	73.34702	98.06077	50.73748	77.36533	68.43643
##	[8,]	100.55480	102.31962	76.32988	92.37238	53.14241	72.59305	66.20400
##	[9,]	88.89572	120.93447	99.08246	121.98956	88.51746	87.94201	75.89076
##	[10,]	104.80849	98.46220	58.80092	82.05516	57.80561	78.93129	56.60468
##	[11,]	64.41625	56.78158	93.38518	104.25340	95.46119	76.70306	89.28896
##	[12,]	109.52985	102.38135	74.71450	48.09762	111.54912	113.09509	96.01425
##	[13,]	95.45755	119.29870	92.56329	88.39368	112.05602	122.51924	109.32334
##	[14,]	86.73686	67.12943	100.83171	93.92751	74.83130	85.48714	83.56330
##	[15,]	104.53805	93.66767	70.53027	87.76035	80.54036	44.34063	57.29458
##	[16,]	94.28775	126.51518	78.14871	84.89995	108.35173	100.19562	87.97597
##	[17,]	98.67143	100.04890	51.03124	94.37854	70.75546	73.73443	59.94705
##	[18,]	104.61915	82.79367	100.23374	108.01277	106.43388	80.45160	114.60409
##	[19,]	68.61924	70.31935	111.25392	88.29816	91.81856	90.33853	87.69562
##	[20,]	70.07525	104.39462	74.77594	73.81803	74.47382	95.52739	81.62255
##	[21,]	93.77811	111.81113	97.20471	91.58892	78.43019	114.55298	87.80224
##	[22,]	82.43321	100.06898	93.30683	78.64327	76.17293	77.21652	78.38162
##	[23,]	89.25561	92.04312	66.46232	60.50810	60.99905	107.38438	71.01251
##	[24,]	100.08274	85.71664	89.74001	89.12696	92.42928	91.35685	95.74470
##	[25,]	70.10133	90.83735	80.43467	64.44708	71.91437	78.39591	76.22127
##	[26,]	118.10813	103.79412	69.44926	60.44787	96.99579	101.38595	99.45433
##	[27,]	114.52573	111.15505	92.07152	99.22345	81.13462	91.05807	95.28254
##	[28,]	84.82691	121.51635	85.15046	92.91458	67.85700	97.14199	78.62860
##	[29,]	119.60299	111.58382	65.16328	78.89247	62.46824	83.32621	62.67256
##	[30,]	35.46898	54.72874	81.76638	95.65067	70.66266	87.11522	98.51736
##	[31,]	79.74016	94.27191	126.13044	119.88658	82.77680	99.49257	97.77323
##	[32,]	93.93495	72.46633	75.37643	73.74392	79.85746	94.79364	104.82717
##	[33,]	105.28332	71.42347	65.30813	89.45862	67.08037	73.57304	65.58779
##	[34,]	61.84902	91.07084	125.64866	128.80047	84.67444	90.44096	100.97227
##	[35,]	55.38560	92.00698	77.74006	81.99448	105.42678	86.02720	88.68021
##	[36,]	109.01541	101.29763	93.76456	94.38122	103.67247	81.43887	74.54395
##	[37,]	95.19448	113.08091	103.83311	80.22166	115.95830	122.26754	111.29447
##	[38,]	83.90486	61.56202	72.83641	76.55075	103.06783	78.00652	90.48758
##	[39,]	106.93254	99.35332	68.26398	109.01406	81.26043	63.51931	78.34656
##	[40,]	100.44214	75.93883	68.45267	72.78482	49.65513	99.42928	78.93675
##	[41,]	63.05786	70.16945	95.87158	115.99681	79.38633	91.95255	110.20242
##	[42,]	100.92432	101.43825	73.69690	91.57887	98.04423	48.69350	58.82864
##	[43,]	101.04759	103.03454	100.80264	80.15616	81.81750	83.07639	71.05593
##	[44,]	71.51927	81.33001	81.98184	123.37410	93.24169	59.11406	96.45944
##	[45,]	77.05115	93.78526	63.26517	61.54358	76.22256	82.45704	68.16628

##	[46,]	118.69615	70.66605	110.82930	92.84016	100.50501	80.86084	93.66579
##	[47,]	96.74202	54.24820	80.62504	85.21426	93.58779	77.89533	99.03989
##	[48,]	97.09839	119.02279	75.83391	102.21079	74.16252	90.96858	87.69719
##	[49,]	47.47916	89.67907	90.73766	111.76894	101.47021	83.80783	98.44285
##	[50,]	105.91436	100.47752	79.18035	97.95985	70.04987	94.97958	84.66712
##	[51,]	89.57417	91.09410	91.66575	83.79598	75.95722	76.16527	70.77520
##	[52,]	102.53905	106.31498	88.99666	97.85189	97.95188	54.06398	67.73427
##	[53,]	50.58925	82.97872	101.19136	116.56556	79.32207	82.11765	84.15133
##	[54,]	70.94971	43.14456	98.53752	88.61215	102.42224	105.17986	118.48886
##	[55,]	102.96979	87.77780	99.78640	121.11780	118.63112	80.83341	94.15977
##	[56,]	84.07609	74.62924	119.55006	65.49429	86.90881	119.54767	103.60958
##	[57,]	78.77523	95.11268	72.15455	95.94995	72.78364	70.09689	79.27611
##	[58,]	NA	73.03808	102.27456	107.55176	85.70005	93.29465	105.92476
##	[59,]	NA	NA	98.02477	89.98378	76.04309	81.28122	98.55960
##	[60,]	NA	NA	NA	68.89059	58.12402	59.23825	45.51710
##	[61,]	NA	NA	NA	NA	80.56911	104.86455	76.17393
##	[62,]	NA	NA	NA	NA	NA	63.76564	50.21964
##	[63,]	NA	NA	NA	NA	NA	NA	45.63460
##	[64,]	NA	NA	NA	NA	NA	NA	NA
##	[65,]	NA	NA	NA	NA	NA	NA	NA
##	[66,]	NA	NA	NA	NA	NA	NA	NA
##	[67,]	NA	NA	NA	NA	NA	NA	NA
##	[68,]	NA	NA	NA	NA	NA	NA	NA
##	[69,]	NA	NA	NA	NA	NA	NA	NA
##	[70,]	NA	NA	NA	NA	NA	NA	NA
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA

##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,65]	[,66]	[,67]	[,68]	[,69]	[,70]	[,71]
##	[1,]	117.48369	91.68741	117.58219	94.10354	104.75001	96.02475	67.66198
##	[2,]	86.81453	74.73172	91.34323	65.29639	86.79052	51.21705	110.50651
##	[3,]	78.73566	89.26760	74.44329	128.47844	98.01132	63.99096	80.94488
##	[4,]	96.18759	75.63635	131.39995	71.74910	99.06007	102.41445	66.66019
##	[5,]	87.82546	91.29496	99.17091	95.05512	87.95362	63.99662	71.79367
##	[6,]	68.17518	82.37894	121.63987	79.12202	73.98139	59.65829	84.33871
##	[7,]	57.87572	93.60479	76.93528	106.98024	104.77630	81.95874	67.96401
##	[8,]	90.13656	71.34709	77.78012	94.99230	100.25304	76.21606	89.58058
##	[9,]	68.09285	88.80913	69.06789	78.98546	96.73434	36.78585	92.09838
##	[10,]	69.75080	79.24839	101.68690	94.38791	104.87853	57.15124	76.98651
##	[11,]	59.96916	90.13578	102.15378	80.38924	79.20257	112.00580	106.59626
##	[12,]	113.36579	112.85262	109.84044	100.90537	101.76298	86.37297	63.94524
##	[13,]	81.81129	130.62656	88.22433	95.40690	94.13882	58.80229	59.72777
##	[14,]	76.10838	69.05688	105.92029	58.39507	97.73098	82.48543	80.67541
##	[15,]	120.81571	82.64583	61.87970	103.01267	112.60771	102.36669	101.58354
##	[16,]	98.62832	125.60206	82.50958	80.27058	115.91932	52.02018	67.13237
##	[17,]	63.36751	89.87021	91.05599	111.58952	96.05008	60.45497	88.82953
##	[18,]	107.14381	102.62185	64.98946	105.87003	63.23765	111.50870	121.11557
##	[19,]	95.03894	60.08145	102.24524	67.18119	89.75663	110.34424	99.54636
##	[20,]	96.72862	89.27862	96.53833	81.60233	108.13045	88.31220	76.08675
##	[21,]	66.15946	84.34454	92.81878	100.65025	90.16647	58.23805	64.58875
##	[22,]	120.62645	86.09595	66.24268	93.99957	117.08528	114.70416	74.42442
##	[23,]	77.28809	56.42126	131.78538	95.16565	91.50173	72.92140	76.86314
##	[24,]	96.70166	90.03404	88.95172	94.47191	88.20827	88.30136	86.49218
##	[25,]	120.96164	86.56386	84.67273	83.27627	125.64367	121.12959	68.30715
##	[26,]	126.12442	103.09147	92.09065	115.50982	89.47560	92.38119	82.61220
##	[27,]	93.05261	101.62628	65.18723	106.53992	88.79008	72.97498	80.90079
##	[28,]	73.85464	96.72461	73.16882	107.67283	105.72385	70.09362	59.45025
##	[29,]	90.58846	82.41580	87.91133	100.07416	110.60357	51.81290	68.68412
##	[30,]	56.63336	88.71672	113.16510	71.97545	82.55979	116.95034	92.26295
##	[31,]	74.62720	68.19121	82.59031	59.02002	81.52499	67.01054	96.69931
##	[32,]	90.72555	91.49402	101.19703	126.20135	65.67260	126.97037	95.80685
##	[33,]	70.31748	47.07572	111.73636	111.70419	63.96521	87.15683	126.37589
##	[34,]	74.46034	77.34779	70.26454	66.60568	79.26119	88.64691	105.29557
##	[35,]	99.18430	111.70435	90.35204	80.89206	108.09468	107.85531	86.47386
##	[36,]	102.76656	84.70823	80.31704	82.46083	104.16287	65.40813	91.01709
##	[37,]	113.68497	98.02783	94.55671	78.13316	86.00185	73.99580	88.24194
##	[38,]	90.49995	104.04584	109.99340	87.06031	89.30882	117.11244	98.31068
##	[39,]	84.07163	105.59891	68.57707	95.32165	94.35929	67.79027	99.89923
##	[40,]	64.80452	56.31279	128.78005	100.67561	77.03265	77.66886	83.47680
##	[41,]	51.37004	91.24395	89.24449	102.74051	55.49083	110.49655	107.74922
##	[42,]	108.36530	111.66800	57.03218	98.14400	127.23452	92.88434	84.51032
##	[43,]	106.30955	81.60947	71.33372	99.90871	115.70475	95.00436	65.97493
##	[44,]	88.44059	102.56963	60.49924	97.93548	73.03734	112.81787	134.36379
##	[45,]	98.85738	102.27711	99.35530	78.55220	139.85289	90.17119	47.05640
##	[46,]	111.58599	64.17941	89.94741	84.60813	72.32844	101.42796	119.09514
##	[47,]	86.88640	89.25156	101.60531	114.64865	60.26330	134.06337	117.44451
##	[48,]	83.81202	100.30730	72.49602	96.39154	94.47233	54.60589	82.86238
##	[49,]	67.13161	125.10447	75.79906	84.23347	94.55041	102.11954	88.77699
##	[50,]	72.05770	66.07739	89.29944	130.64968	58.28190	76.38493	110.74844
##	[51,]	107.91885	58.43855	83.17305	95.28261	93.76714	105.82140	104.17598
##	[52,]	119.95400	98.79571	46.47651	96.71147	113.24629	97.47997	99.52833

##	[53,]	48.50302	90.78707	86.71692	69.45497	93.10768	89.77714	90.44154
##	[54,]	67.81187	87.93684	128.67911	81.31281	55.90793	119.27718	105.35207
##	[55,]	74.95853	102.97668	82.22746	77.52823	76.09136	65.50834	116.25379
##	[56,]	90.45843	80.35752	117.67668	66.36581	99.62715	102.60784	50.13203
##	[57,]	72.97327	119.33985	67.65324	111.52558	106.95248	102.83297	70.26530
##	[58,]	67.22543	96.97869	95.14320	54.83106	90.62576	109.85903	90.07764
##	[59,]	68.83412	63.36207	125.06283	72.72775	66.10318	133.13838	109.14679
##	[60,]	90.44397	88.52256	91.41093	125.74870	109.36740	86.74835	86.36605
##	[61,]	121.50440	77.54853	123.13048	102.48347	112.80168	102.16032	54.23405
##	[62,]	68.27609	54.79894	101.04953	101.69481	101.32619	95.44962	82.73310
##	[63,]	85.41488	86.51160	63.49878	101.49557	108.13006	100.62187	107.97394
##	[64,]	90.16371	70.94391	83.18177	108.00162	126.30989	79.50818	81.36265
##	[65,]	NA	81.12689	101.84044	83.82491	66.98510	81.81004	102.89210
##	[66,]	NA	NA	122.04326	88.06702	76.35648	95.82328	103.43810
##	[67,]	NA	NA	NA	102.04528	104.91809	78.33937	97.35800
##	[68,]	NA	NA	NA	NA	97.10389	91.10361	84.66181
##	[69,]	NA	NA	NA	NA	NA	97.48310	135.30855
##	[70,]	NA	NA	NA	NA	NA	NA	82.11825
##	[71,]	NA	NA	NA	NA	NA	NA	NA
##	[72,]	NA	NA	NA	NA	NA	NA	NA
##	[73,]	NA	NA	NA	NA	NA	NA	NA
##	[74,]	NA	NA	NA	NA	NA	NA	NA
##	[75,]	NA	NA	NA	NA	NA	NA	NA
##	[76,]	NA	NA	NA	NA	NA	NA	NA
##	[77,]	NA	NA	NA	NA	NA	NA	NA
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,72]	[,73]	[,74]	[,75]	[,76]	[,77]	[,78]
##	[1,]	89.58882	88.28007	66.41958	89.48496	65.23796	65.65034	84.38616
##	[2,]	92.98660	102.60761	108.36788	51.13911	82.37317	73.18839	79.02970
##	[3,]	60.72349	103.37392	76.51426	131.32796	89.92394	117.64694	57.76547
##	[4,]	82.68293	82.52689	71.61400	94.94100	79.45335	77.25857	69.15064
##	[5,]	103.50788	85.48359	83.95211	87.65273	93.78245	74.54203	81.35075

##	[6,]	107.84964	80.24772	87.85974	59.96225	99.14662	73.44250	77.87170
##	[7,]	81.99316	112.01631	92.34551	105.49397	119.67130	112.36640	95.91227
##	[8,]	79.10277	92.20143	98.93464	93.19403	80.85540	128.66243	83.53035
##	[9,]	99.67262	121.07706	111.87982	65.22590	111.40734	82.90561	92.74866
##	[10,]	78.75813	115.38524	81.46180	76.68795	93.07180	104.42120	77.49743
##	[11,]	83.75730	105.26783	113.82012	67.34944	108.36714	42.11245	115.12679
##	[12,]	107.64930	84.78128	45.83941	87.16083	78.78964	91.46360	84.91827
##	[13,]	124.08672	101.20926	46.10083	90.63037	122.34787	100.32789	87.18931
##	[14,]	80.57228	103.86102	93.53956	85.42623	97.81987	80.54919	75.76033
##	[15,]	54.04505	103.31694	106.86618	117.77679	57.84607	84.63017	80.00392
##	[16,]	119.93438	111.17164	69.14684	72.78390	102.78589	88.62044	77.79868
##	[17,]	59.37075	122.76602	82.30058	101.91615	96.64669	81.91286	63.11488
##	[18,]	89.78476	71.81776	77.06272	112.16845	83.48487	117.12602	103.23019
##	[19,]	80.40484	78.22964	135.20069	78.03501	73.99056	47.97571	92.53852
##	[20,]	101.44527	77.09870	102.22497	77.58312	83.30198	97.64108	77.67094
##	[21,]	93.46322	97.79690	80.63974	98.35404	110.20637	101.07749	84.24705
##	[22,]	84.83949	80.20525	108.23702	117.87324	74.72725	102.72250	93.70084
##	[23,]	72.20282	77.74455	91.98584	83.81497	71.32004	87.25988	55.60424
##	[24,]	73.57167	89.47997	70.52559	125.18502	85.54205	91.76864	61.96780
##	[25,]	84.77871	76.30308	107.00836	109.69773	70.62249	92.57526	79.60592
##	[26,]	89.07068	65.41990	43.45940	120.93394	62.56221	125.29830	65.13922
##	[27,]	99.29972	91.66095	61.21794	111.01771	100.94792	157.31889	93.98393
##	[28,]	93.30938	101.63040	87.05391	109.84546	112.83871	113.35444	88.54130
##	[29,]	76.74395	108.49019	66.80846	103.81765	84.19841	122.62188	61.59903
##	[30,]	85.72460	81.29335	104.80224	85.71146	111.66737	74.59097	81.01470
##	[31,]	103.20997	88.01710	116.60466	69.96048	103.97366	96.88999	92.62347
##	[32,]	77.85721	57.05985	65.73865	121.56572	81.06826	120.85193	93.61351
##	[33,]	42.75014	87.72738	105.96673	83.27327	62.81528	80.55745	80.53650
##	[34,]	102.30521	83.53266	134.16913	76.56498	108.21232	90.74053	105.30198
##	[35,]	96.59739	91.61645	108.02963	82.85987	90.07776	46.61631	84.71718
##	[36,]	77.34056	114.74787	94.14474	92.19456	78.46912	63.46952	73.97547
##	[37,]	126.18938	65.87174	82.29459	65.75194	78.64882	98.25226	87.58796
##	[38,]	88.68226	95.17061	83.24449	73.22225	87.12660	62.61426	101.45890
##	[39,]	84.90061	115.08713	73.85114	93.47859	99.44272	115.00022	81.45829
##	[40,]	65.22286	79.56747	73.44925	97.08620	82.39116	112.70340	60.98660
##	[41,]	83.40083	77.07139	96.55724	104.60944	117.20500	97.01260	100.00787
##	[42,]	77.71232	135.29900	96.07637	100.10452	87.73784	68.08618	101.38547
##	[43,]	81.30366	101.41947	98.98061	112.56182	83.70060	91.81892	103.30049
##	[44,]	77.41125	85.52390	111.20775	102.36845	91.33147	87.75079	92.53502
##	[45,]	85.33170	108.65430	80.54433	102.32998	91.46993	76.54783	60.88641
##	[46,]	80.11111	78.42217	96.88081	82.68657	60.01510	92.18697	104.97368
##	[47,]	73.86832	75.16084	81.52005	96.25204	79.92225	90.86408	113.99320
##	[48,]	94.27359	95.01315	72.33463	104.02957	101.33418	132.04288	63.37309
##	[49,]	105.95476	106.94463	104.63288	82.50851	130.41448	63.22156	108.41499
##	[50,]	65.16049	74.91815	91.25146	106.83321	79.28835	114.98691	82.14451
##	[51,]	72.47716	75.34449	131.05704	88.83087	56.68942	86.17297	97.78565
##	[52,]	86.04974	109.78551	111.96211	91.51625	75.72620	85.45441	114.46957
##	[53,]	102.33157	110.76002	128.49675	56.59922	128.93198	68.06188	118.60613
##	[54,]	91.87254	71.44889	84.28943	76.36230	99.42939	66.50262	98.38161
##	[55,]	100.29079	120.76463	89.64727	53.94363	106.38177	67.41399	107.99948
##	[56,]	114.21907	78.23805	79.88575	79.04740	100.38134	95.65566	107.60922
##	[57,]	89.48881	113.53904	80.66629	112.40848	122.51026	106.78967	109.50757
##	[58,]	106.48667	82.08398	122.87276	74.20852	119.09701	66.87720	90.73429
##	[59,]	74.93964	75.79061	102.48001	77.39257	89.93447	76.86675	103.67254

##	[60,]	48.67163	105.96380	81.63751	113.60130	69.89200	95.97246	61.41184
##	[61,]	79.58267	72.56185	66.12624	105.84520	52.46484	93.75030	69.67787
##	[62,]	48.08998	96.13858	104.02356	106.58955	82.94466	108.27890	74.03382
##	[63,]	52.71001	126.23797	113.66430	98.96650	85.15537	85.14520	97.48627
##	[64,]	46.36394	126.38023	105.62031	99.11261	70.56721	84.85617	78.66853
##	[65,]	84.92065	105.30260	103.23583	70.56444	130.37499	85.26076	100.77969
##	[66,]	53.39940	72.66631	113.66269	85.56773	58.29506	88.56290	77.83723
##	[67,]	96.45252	116.06648	97.58889	106.37588	103.95320	101.75519	103.81808
##	[68,]	121.23944	89.86826	113.32399	49.11463	109.49254	63.17728	94.82448
##	[69,]	89.69806	58.53446	87.96951	81.31275	92.78183	97.21796	99.74076
##	[70,]	98.99268	114.87349	80.30356	78.74413	99.48347	94.58967	72.52330
##	[71,]	106.82789	99.39227	66.29541	101.85001	98.60806	98.48462	81.28348
##	[72,]	NA	96.04490	101.46943	116.61239	57.15913	90.96779	69.23295
##	[73,]	NA	NA	84.59022	98.78664	66.61635	104.08906	77.03750
##	[74,]	NA	NA	NA	112.33624	90.56916	120.72020	81.90983
##	[75,]	NA	NA	NA	NA	106.52502	58.71260	112.82797
##	[76,]	NA	NA	NA	NA	NA	90.90495	65.20660
##	[77,]	NA	NA	NA	NA	NA	NA	93.15377
##	[78,]	NA	NA	NA	NA	NA	NA	NA
##	[79,]	NA	NA	NA	NA	NA	NA	NA
##	[80,]	NA	NA	NA	NA	NA	NA	NA
##	[81,]	NA	NA	NA	NA	NA	NA	NA
##	[82,]	NA	NA	NA	NA	NA	NA	NA
##	[83,]	NA	NA	NA	NA	NA	NA	NA
##	[84,]	NA	NA	NA	NA	NA	NA	NA
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,79]	[,80]	[,81]	[,82]	[,83]	[,84]	[,85]
##	[1,]	51.21598	102.47155	94.13407	79.38183	96.45165	122.09213	38.15746
##	[2,]	69.47745	67.89993	77.93881	77.42896	96.00366	97.63216	78.76793
##	[3,]	110.48287	85.09459	115.84705	123.80221	81.83703	48.64552	121.65689
##	[4,]	87.91256	105.53050	80.76079	85.58007	81.78874	125.56622	65.90388
##	[5,]	62.08209	96.60906	95.95904	81.99175	105.49612	105.22410	70.57925
##	[6,]	68.88881	89.82021	103.45890	84.34429	121.67303	115.51315	82.07672
##	[7,]	118.17920	83.89776	104.69096	108.72863	65.27352	69.19713	137.70104
##	[8,]	115.54574	56.20581	96.94593	90.72084	75.10361	53.22032	112.71163
##	[9,]	77.51678	67.35172	80.86225	87.34747	81.09105	86.16024	102.26294
##	[10,]	91.66241	61.41546	111.46027	104.85480	81.51523	84.87751	108.57867
##	[11,]	83.47145	112.41223	89.10581	76.15289	82.22090	117.83255	96.82033
##	[12,]	59.35653	93.91328	106.29375	106.19186	119.21998	108.91681	60.11978

##	[13,]	67.88340	89.61156	97.02637	128.68715	112.91642	106.77681	89.29509
##	[14,]	96.77115	86.67977	66.02089	83.88582	59.96349	113.73476	88.23077
##	[15,]	98.88749	96.72833	75.94003	84.13992	60.55175	60.53062	83.03085
##	[16,]	67.84741	89.47266	81.65516	122.86118	111.56602	99.81699	80.77032
##	[17,]	89.70930	93.28585	112.46045	118.45930	82.90453	81.80722	111.81699
##	[18,]	97.56618	80.95931	91.65010	98.60396	98.45675	67.69537	94.21753
##	[19,]	89.77689	111.11691	66.57147	38.68401	76.05590	105.05664	69.19957
##	[20,]	108.50915	97.58657	90.69076	93.29213	106.77299	77.03583	96.59730
##	[21,]	86.01076	77.67251	103.52311	93.14953	82.48168	91.10087	101.20138
##	[22,]	114.85336	100.54172	69.98530	75.54392	65.54486	62.88223	87.08470
##	[23,]	95.41201	89.91703	117.87945	82.84082	100.86452	90.19642	91.02183
##	[24,]	94.25478	103.06508	81.34450	105.50668	81.45112	91.18683	83.86877
##	[25,]	121.42734	117.79445	68.18395	82.83923	76.04364	73.55903	84.56227
##	[26,]	90.59079	88.14502	108.36217	117.34863	117.60825	71.20514	77.00355
##	[27,]	100.51081	52.10159	98.77024	114.11767	85.02281	62.93707	108.88923
##	[28,]	105.09311	84.60351	99.52019	104.51105	76.61593	69.57007	116.65458
##	[29,]	94.96041	60.05491	100.63972	112.85378	76.23698	72.99038	99.29339
##	[30,]	128.93841	130.55844	87.22312	102.21568	95.11072	101.40516	119.93586
##	[31,]	98.33482	65.59047	66.93176	68.73371	77.82264	89.83446	98.24905
##	[32,]	112.00156	95.91295	128.27221	102.24494	105.80636	71.41606	105.65603
##	[33,]	89.74070	74.93400	130.40026	71.16913	89.79346	77.41633	100.12776
##	[34,]	110.00351	83.87847	65.44865	67.00267	78.61256	79.87104	108.00336
##	[35,]	89.28458	148.64748	74.71545	95.13318	105.87564	100.05018	80.75854
##	[36,]	63.26967	89.57725	68.52781	82.35121	72.05297	100.43855	63.82617
##	[37,]	70.39385	78.61000	87.29222	85.18266	131.10858	93.94049	65.36163
##	[38,]	77.82452	110.86362	96.44392	95.47701	102.36770	114.86787	80.51853
##	[39,]	97.59585	67.89579	93.12059	128.71256	87.06961	70.85441	113.61316
##	[40,]	107.95982	73.02046	125.91576	96.96623	90.57580	86.05751	108.65188
##	[41,]	119.84278	104.66903	106.47315	99.29586	93.99309	80.56502	131.59979
##	[42,]	74.83453	100.29190	71.59133	95.93757	59.44016	86.66931	80.32154
##	[43,]	86.89998	85.06208	77.61348	66.82264	47.76238	82.31045	78.22183
##	[44,]	116.02449	109.99736	84.98426	103.45379	97.28891	60.16113	115.40440
##	[45,]	100.03216	123.30452	72.38463	113.46332	77.27854	101.77909	84.65590
##	[46,]	75.06964	60.61905	83.38905	52.89542	78.88010	91.36136	64.67147
##	[47,]	91.03034	92.99953	119.89196	85.36013	98.11304	89.10561	94.90113
##	[48,]	109.69061	72.44270	95.18596	130.52888	98.03638	60.90307	117.33318
##	[49,]	95.86932	128.15960	79.31304	107.10625	94.63152	99.90336	110.61016
##	[50,]	99.68999	67.61468	137.04078	86.57362	98.30754	53.74402	114.03964
##	[51,]	99.12733	84.36605	89.16817	45.71153	76.94313	65.47111	82.89456
##	[52,]	81.10165	81.37468	72.05927	75.14372	67.28960	68.63746	79.88600
##	[53,]	98.55489	94.97171	80.64150	78.58737	76.30480	101.87174	116.92049
##	[54,]	87.06254	112.56117	101.24039	85.62477	109.86582	125.57894	88.53561
##	[55,]	51.91233	71.11254	84.69444	92.53338	94.64870	112.84012	84.31794
##	[56,]	86.27053	83.12203	78.48652	67.49836	76.63151	125.34203	72.59285
##	[57,]	111.05583	98.80012	99.00164	120.54829	71.31030	75.32223	127.12753
##	[58,]	121.32886	132.89937	63.54986	91.58455	95.89085	102.26911	110.49209
##	[59,]	107.08312	96.77818	92.11660	68.17939	79.15698	112.82478	96.88895
##	[60,]	104.82930	98.18912	121.36115	117.58899	86.64099	60.29849	108.17630
##	[61,]	83.44432	98.44127	104.61401	82.90327	92.85606	97.03186	58.16360
##	[62,]	134.85047	82.59130	108.71192	89.60268	57.62362	64.18009	126.50949
##	[63,]	108.03714	87.58925	87.84404	94.44995	51.51618	63.62671	114.34342
##	[64,]	96.24195	81.28561	100.31600	87.10355	51.17163	67.97314	99.45309
##	[65,]	105.38732	83.61764	105.52818	96.26957	83.48611	98.84240	136.44051
##	[66,]	102.94308	72.81128	104.38718	46.76226	72.17210	85.69741	88.74991

##	[67,]	91.63603	84.57667	71.83482	108.42582	76.80238	57.37560	103.76452
##	[68,]	90.31343	101.59534	38.33108	73.65488	87.46761	129.91514	77.81141
##	[69,]	89.54622	77.49494	115.39241	80.88057	118.18464	91.49619	100.88036
##	[70,]	66.08197	64.53710	93.01878	105.52755	96.44609	87.17376	89.80158
##	[71,]	87.40457	97.95835	79.21710	101.67520	77.43696	104.55887	76.77076
##	[72,]	109.89317	87.62897	117.44659	83.87211	65.22374	60.32009	105.30429
##	[73,]	103.73089	100.32382	99.63365	75.00244	124.42929	87.16228	77.22659
##	[74,]	72.52077	79.29121	111.84607	122.79156	108.43181	95.94581	78.50504
##	[75,]	66.34461	79.66462	76.17393	66.91784	99.24466	128.32073	80.69718
##	[76,]	85.19383	87.10743	104.69152	67.18783	93.39512	71.77824	59.70196
##	[77,]	69.55114	120.43370	67.73470	69.45666	89.59664	123.87992	69.68393
##	[78,]	106.11859	109.01414	94.55157	109.54412	104.63738	74.51359	87.60863
##	[79,]	NA	72.85950	90.60793	77.99792	102.16287	119.77132	46.05697
##	[80,]	NA	NA	109.26342	77.36950	76.48704	81.81489	92.60160
##	[81,]	NA	NA	NA	82.29916	75.97918	109.47283	73.31309
##	[82,]	NA	NA	NA	NA	74.18528	105.35476	64.29776
##	[83,]	NA	NA	NA	NA	NA	85.16839	100.46133
##	[84,]	NA	NA	NA	NA	NA	NA	118.30616
##	[85,]	NA	NA	NA	NA	NA	NA	NA
##	[86,]	NA	NA	NA	NA	NA	NA	NA
##	[87,]	NA	NA	NA	NA	NA	NA	NA
##	[88,]	NA	NA	NA	NA	NA	NA	NA
##	[89,]	NA	NA	NA	NA	NA	NA	NA
##	[90,]	NA	NA	NA	NA	NA	NA	NA
##	[91,]	NA	NA	NA	NA	NA	NA	NA
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,86]	[,87]	[,88]	[,89]	[,90]	[,91]	[,92]
##	[1,]	117.17086	99.76824	77.19274	102.20514	82.06217	70.25407	66.42860
##	[2,]	86.19732	59.67299	110.74091	91.67829	71.58306	110.08299	64.11367
##	[3,]	90.91883	86.06422	93.32510	114.42524	80.88929	117.73678	104.33998
##	[4,]	104.05297	114.71076	71.08582	119.22229	105.37691	89.38600	74.08386
##	[5,]	72.32849	69.59685	108.85769	114.24108	76.54855	76.44481	78.65588
##	[6,]	71.01736	69.23818	129.85966	97.62829	93.24642	82.89269	64.86924
##	[7,]	75.32045	105.28185	96.48943	103.91871	120.84136	92.93647	103.20326
##	[8,]	75.22198	77.11230	76.27592	92.67061	101.77811	94.77021	98.38858
##	[9,]	69.00108	66.09816	120.48816	102.43268	82.96226	104.17860	81.04390
##	[10,]	99.42453	95.15601	100.27885	98.46433	111.40503	104.13852	75.94908
##	[11,]	94.29102	100.65708	115.53708	81.77365	97.51422	97.54367	63.82212
##	[12,]	121.31250	107.87272	87.60439	75.94790	93.76381	61.26614	86.11337
##	[13,]	104.44106	112.57960	108.95207	86.23109	98.34162	80.66990	110.18969
##	[14,]	91.01165	105.07456	80.26695	127.13679	104.06482	114.84684	80.06427
##	[15,]	101.44272	82.45727	63.18167	102.74859	58.51791	106.38206	87.07538
##	[16,]	104.41460	101.24154	112.77409	79.05713	91.19192	78.03599	87.24698
##	[17,]	107.39648	93.59298	115.09319	111.86290	80.76845	131.47065	76.75609
##	[18,]	108.76857	92.42169	66.00269	56.92279	69.94750	101.86722	135.62529
##	[19,]	58.95333	65.29431	88.83453	112.43576	80.10064	81.62189	54.92496

##	[20,]	62.78936	79.76273	102.11563	80.26938	108.49001	57.72421	75.25306
##	[21,]	70.25570	83.88259	99.73293	124.80781	98.96379	92.22049	95.94175
##	[22,]	64.97583	85.59343	55.73019	103.15187	90.56307	63.19012	101.24733
##	[23,]	70.77094	68.62026	105.17044	116.85914	100.08924	87.43264	52.72058
##	[24,]	105.76076	101.35752	74.34453	118.18357	71.95777	117.91051	104.20843
##	[25,]	68.09716	94.29969	65.42674	100.47928	100.74919	56.58446	84.87099
##	[26,]	116.09839	96.43602	66.29516	76.52026	77.76327	82.47198	114.21922
##	[27,]	97.43892	100.02023	67.42638	83.26576	98.12293	95.70026	143.91621
##	[28,]	65.24735	91.04543	95.05396	112.47832	105.50315	81.78110	106.75160
##	[29,]	102.18730	95.24167	77.82091	114.26313	96.05894	108.94253	97.37132
##	[30,]	75.18758	110.53433	114.26839	86.02724	121.19858	92.71727	77.25772
##	[31,]	49.16561	65.26573	94.13469	105.93700	95.19753	97.80987	92.72365
##	[32,]	100.75012	102.41352	72.75762	68.69835	99.71308	83.16039	115.52108
##	[33,]	94.07304	58.43688	100.99082	94.37532	74.53604	124.08082	59.21722
##	[34,]	36.45294	64.86975	98.54590	92.69877	93.24557	88.88085	96.36538
##	[35,]	84.40149	93.66018	116.59437	79.48182	83.65362	67.72002	62.82559
##	[36,]	102.98765	79.85503	87.14738	122.87230	54.91672	115.22824	74.86878
##	[37,]	79.18228	68.07228	97.00435	66.53614	83.85949	57.75524	89.02152
##	[38,]	125.35637	116.01409	99.28677	60.11637	97.49657	85.01119	70.25401
##	[39,]	119.42717	105.55501	91.88377	73.78519	88.75388	122.88053	110.54879
##	[40,]	89.20014	89.31988	88.94930	112.06279	110.84698	110.38902	82.34762
##	[41,]	75.04669	95.11815	105.51003	81.15453	100.55276	104.01737	109.42460
##	[42,]	118.60805	107.01482	81.29979	94.21248	72.01083	96.44799	85.34639
##	[43,]	77.71136	87.86053	57.85760	125.79591	86.88069	76.82757	95.55910
##	[44,]	90.90189	84.28388	100.42858	58.41057	68.29622	110.46463	104.08276
##	[45,]	98.87213	122.99699	88.72045	116.20786	106.94460	81.05160	73.23760
##	[46,]	101.63913	72.39841	56.13725	84.66315	69.91035	101.03586	91.70031
##	[47,]	117.51923	101.50931	80.16490	55.92251	90.27710	93.97238	96.29521
##	[48,]	87.18744	90.39746	95.74123	90.87049	92.89545	106.28741	116.74735
##	[49,]	83.50600	109.35585	126.76015	72.73647	99.97731	81.38975	88.79709
##	[50,]	74.96835	53.18101	96.35938	95.07611	74.89256	109.94107	98.18549
##	[51,]	59.08476	49.45116	75.40094	95.16909	77.42585	75.16443	72.19373
##	[52,]	95.34872	80.73204	72.08529	78.47984	68.67182	82.12647	92.86898
##	[53,]	60.48840	91.49387	124.11221	85.92765	118.03052	83.14118	73.06072
##	[54,]	100.83119	105.51764	105.01883	74.01259	102.10704	92.99043	78.79693
##	[55,]	119.56496	91.09446	114.09041	69.84146	74.11632	118.45787	83.44502
##	[56,]	76.59927	110.95103	66.47193	106.84365	134.56167	52.69848	90.51443
##	[57,]	98.32965	128.98208	89.81617	82.11111	116.40005	85.10090	115.48472
##	[58,]	52.69217	97.57726	120.06901	83.91274	114.10738	76.36219	78.33966
##	[59,]	93.60845	105.40893	81.74884	84.17207	114.86533	100.05091	76.76471
##	[60,]	111.59732	95.41011	93.97504	95.00367	85.52115	106.54991	76.28090
##	[61,]	99.48299	96.88299	62.11650	109.96320	98.48034	59.80660	72.64508
##	[62,]	75.99678	91.90039	80.02182	116.87644	116.11451	106.25638	79.74716
##	[63,]	106.80782	98.19322	83.63281	87.48521	84.89251	118.94836	84.44448
##	[64,]	97.59678	86.30981	83.30530	117.15375	88.11059	105.93858	63.43239
##	[65,]	79.74101	97.11393	125.34295	88.96538	117.02019	117.31834	84.50568
##	[66,]	69.06713	59.50584	75.66782	119.73118	92.82318	104.06670	60.89782
##	[67,]	93.05744	88.85802	88.41029	77.91318	66.69507	98.05026	121.94129
##	[68,]	68.02183	96.64711	101.46171	92.69467	110.46512	77.41831	72.56622
##	[69,]	87.53126	70.69792	102.10423	65.43438	80.64731	109.65829	101.74329
##	[70,]	90.32649	72.68419	113.04210	105.06560	74.65404	107.12657	87.73975
##	[71,]	87.68037	118.91521	74.75471	119.02988	118.69567	55.84034	92.03375
##	[72,]	99.26169	77.76579	77.23064	112.96758	76.46115	126.03728	72.67137
##	[73,]	67.95075	69.97003	78.02735	81.53192	87.60456	69.06597	96.42275

##	[74,]	128.75112	117.34048	73.19287	84.66958	92.82524	85.52928	120.60242
##	[75,]	80.99570	82.09778	120.38063	72.89952	103.22822	82.68888	60.13302
##	[76,]	95.48777	59.88992	61.96160	102.46817	60.63982	87.77693	70.04633
##	[77,]	86.59574	83.82982	118.01385	95.08113	79.48069	88.67182	41.41962
##	[78,]	83.48962	75.96485	95.32486	118.36379	74.26211	102.81126	76.30422
##	[79,]	115.63975	83.26028	94.63292	84.62378	67.53560	82.44897	80.18671
##	[80,]	100.64486	78.53314	73.19244	88.72415	91.15543	105.21446	104.21417
##	[81,]	74.05641	99.20763	87.40817	97.01775	91.65535	75.97561	88.43605
##	[82,]	67.15418	60.84365	74.47927	103.13754	88.07653	77.51441	62.03492
##	[83,]	90.80995	105.01396	62.96759	121.79194	105.22574	103.09939	86.77425
##	[84,]	83.34019	69.33348	80.48883	88.29919	69.32721	105.78371	109.93136
##	[85,]	100.02893	80.64565	70.66386	98.55759	69.49972	62.91802	73.94098
##	[86,]	NA	60.26534	102.61684	106.18820	100.00921	72.28790	79.23682
##	[87,]	NA	NA	101.10562	96.77492	52.63998	96.48859	71.22763
##	[88,]	NA	NA	NA	104.54271	93.07532	79.50535	110.13054
##	[89,]	NA	NA	NA	NA	88.36608	83.13057	108.52969
##	[90,]	NA	NA	NA	NA	NA	108.62773	89.22366
##	[91,]	NA	NA	NA	NA	NA	NA	88.51887
##	[92,]	NA	NA	NA	NA	NA	NA	NA
##	[93,]	NA	NA	NA	NA	NA	NA	NA
##	[94,]	NA	NA	NA	NA	NA	NA	NA
##	[95,]	NA	NA	NA	NA	NA	NA	NA
##	[96,]	NA	NA	NA	NA	NA	NA	NA
##	[97,]	NA	NA	NA	NA	NA	NA	NA
##	[98,]	NA	NA	NA	NA	NA	NA	NA
##	[99,]	NA	NA	NA	NA	NA	NA	NA
##	[100,]	NA	NA	NA	NA	NA	NA	NA
##		[,93]	[,94]	[,95]	[,96]	[,97]	[,98]	[,99]
##	[1,]	94.56245	81.15173	66.97366	100.21986	73.53024	109.54199	87.83115
##	[2,]	47.78955	91.11890	77.86527	99.64335	106.21228	125.66504	75.33441
##	[3,]	112.75241	94.97757	93.11813	101.53902	95.96925	87.29441	93.57788
##	[4,]	91.59914	76.93351	73.48016	62.52104	77.33218	100.28584	116.77044
##	[5,]	73.98583	52.75492	55.74445	114.29698	114.82685	106.21237	78.46179
##	[6,]	56.54886	65.46559	53.19178	114.57049	139.65701	99.66023	72.78876
##	[7,]	119.98150	90.57369	122.04558	94.48548	95.89215	78.61913	93.36534
##	[8,]	85.58707	116.80321	122.52236	89.04783	85.97195	89.37366	61.90705
##	[9,]	68.28522	74.61727	94.51699	107.70544	113.63184	122.17941	78.35161
##	[10,]	92.75261	105.79587	107.99214	104.74523	100.96851	107.61016	75.81120
##	[11,]	106.66859	92.02815	85.20490	100.11491	97.94377	81.62797	111.60321
##	[12,]	90.67916	83.43537	76.99395	102.63450	84.32259	96.88607	76.98807
##	[13,]	87.77424	49.30087	81.29492	94.60153	110.24739	103.94122	100.50309
##	[14,]	84.49756	76.06377	91.27134	56.29202	86.47049	115.41325	125.17770
##	[15,]	109.49943	113.78317	99.19434	82.54911	41.91488	95.25333	96.42587
##	[16,]	72.02565	67.95416	83.35340	92.18996	90.41775	113.41497	85.53019
##	[17,]	111.33758	91.86733	80.70231	109.53000	103.27726	102.09904	108.15596
##	[18,]	98.68955	107.30907	102.33087	78.36482	81.70447	72.23082	98.07685
##	[19,]	76.12207	85.53347	70.01906	86.23904	82.18531	89.77749	88.18973
##	[20,]	71.63641	96.73159	89.70892	91.33037	87.11806	70.88859	55.93254
##	[21,]	90.75343	62.69824	87.25726	104.61982	118.54072	104.04963	87.01902
##	[22,]	100.13146	94.35289	108.33004	71.63096	48.22816	75.05241	79.83205
##	[23,]	77.90027	96.11683	66.73169	112.14351	111.80091	87.97312	62.85211
##	[24,]	99.69829	73.52024	72.98060	65.94214	81.48967	98.98903	131.97380
##	[25,]	95.72925	95.43662	96.94466	63.19579	42.55262	67.16997	83.78636
##	[26,]	92.65800	99.82499	82.09983	85.82310	77.23068	79.61906	80.51593

##	[27,]	95.70507	92.64560	124.24768	81.18864	91.86924	94.04376	84.89168
##	[28,]	103.23950	73.12329	105.20704	97.86747	99.19442	87.26800	83.54645
##	[29,]	92.14682	94.71847	105.30658	87.43243	87.52126	115.63583	85.69929
##	[30,]	97.80568	87.86411	80.23189	68.06262	98.52844	49.43834	119.60981
##	[31,]	52.99025	75.61182	96.65875	77.24192	110.30796	106.39451	82.42679
##	[32,]	119.66890	114.37319	95.66196	94.57708	92.15483	40.39130	86.60568
##	[33,]	96.43806	134.06371	80.90462	130.48005	112.08134	86.39472	70.27588
##	[34,]	66.85846	81.03267	99.44098	79.20916	103.20056	83.10864	83.68200
##	[35,]	90.80676	79.54780	63.86875	90.08962	73.93290	71.81258	97.34304
##	[36,]	83.03237	73.97044	72.99737	88.57227	78.64124	137.31991	107.82203
##	[37,]	43.32600	81.99255	75.02297	98.44678	101.06114	94.80231	48.47431
##	[38,]	105.80922	105.39817	84.93767	93.79491	79.12134	79.18106	102.17621
##	[39,]	96.58346	105.08158	113.02202	81.56836	87.32207	100.64446	102.61451
##	[40,]	93.06169	104.47468	87.17374	95.87267	115.27534	85.60518	84.78257
##	[41,]	109.67330	90.39582	90.44721	89.77369	116.38150	48.08336	110.48781
##	[42,]	120.15880	93.19004	105.86815	90.29288	45.83963	111.14653	108.78994
##	[43,]	108.54468	81.66762	108.39422	89.09942	63.37128	105.37990	86.81664
##	[44,]	100.38626	110.83172	91.00514	82.78707	82.91892	55.60788	105.41979
##	[45,]	102.73563	72.98605	83.74654	64.06345	58.32600	95.81088	116.09792
##	[46,]	79.24689	113.69267	98.84917	88.24013	79.88167	106.48526	78.69354
##	[47,]	121.11760	126.09485	97.48234	104.26560	89.39640	58.95382	91.81960
##	[48,]	80.83508	86.03135	99.03446	80.24309	101.02502	92.20594	89.25113
##	[49,]	105.14185	71.06891	87.51370	89.32652	93.34399	69.44900	114.76783
##	[50,]	95.16895	111.22582	86.95808	128.99961	124.95765	75.70595	61.98236
##	[51,]	84.01910	117.67651	96.48848	105.27608	75.69501	80.13315	48.51152
##	[52,]	99.75331	108.46718	116.61470	96.16540	51.42080	100.75952	75.05245
##	[53,]	89.78687	82.77038	104.94192	96.93781	106.60539	83.74776	90.51951
##	[54,]	94.56071	88.43692	67.94995	88.68681	110.71046	68.04058	112.20336
##	[55,]	79.59573	87.43561	89.53683	103.83841	107.60449	124.22370	101.99103
##	[56,]	84.12593	68.71802	102.14334	70.48243	86.90066	97.12374	87.62154
##	[57,]	139.85975	91.17080	125.63641	86.81132	77.99461	69.57447	108.67715
##	[58,]	78.65997	71.34505	79.43905	63.91167	95.37605	58.22149	109.73252
##	[59,]	100.16902	110.53949	95.13038	73.84427	92.68938	69.39631	109.28221
##	[60,]	122.67595	122.34561	92.55139	108.26895	75.74220	79.19506	86.14376
##	[61,]	97.78790	95.46979	78.93252	93.17358	67.06471	89.96518	71.39924
##	[62,]	114.06342	120.36533	113.54860	87.95709	85.15500	74.79095	86.58488
##	[63,]	125.34525	128.45497	123.26480	90.18001	60.22401	88.79817	102.21662
##	[64,]	116.83955	119.24463	109.99566	107.23893	65.76707	105.48908	80.20030
##	[65,]	97.83804	91.21785	98.99900	98.32951	132.21457	80.91828	106.17803
##	[66,]	82.49321	117.84824	87.00752	98.93745	99.11337	90.32483	69.14773
##	[67,]	100.55992	86.62259	113.36679	87.38615	71.62924	96.78841	96.42929
##	[68,]	51.47226	61.64780	82.85293	52.71381	90.00361	102.03630	105.76602
##	[69,]	78.59253	101.30496	75.71385	104.95622	137.23632	69.92683	86.04898
##	[70,]	67.72558	70.43602	81.82279	109.22119	113.90869	132.07479	79.36288
##	[71,]	96.86436	59.16024	96.52873	73.64757	69.86156	103.93801	93.62020
##	[72,]	121.81181	134.98780	93.99324	105.58898	79.47587	82.17484	89.26097
##	[73,]	67.43320	92.36989	62.97062	83.06332	102.20716	55.54572	71.31461
##	[74,]	102.15976	78.97326	88.70168	90.12938	92.17211	97.57013	96.47014
##	[75,]	56.11444	83.06074	86.38285	98.44469	112.87385	107.72032	78.89415
##	[76,]	86.86606	121.05847	73.45902	104.41874	69.68530	90.53414	59.01802
##	[77,]	79.09104	77.54952	62.61479	95.08510	87.37077	101.81683	102.00983
##	[78,]	77.41700	85.48726	53.81474	82.42286	89.02717	87.48727	92.09924
##	[79,]	76.25818	74.19792	76.88249	117.81005	97.21235	134.98498	77.30572
##	[80,]	86.91743	108.57416	121.45236	110.60785	106.01417	118.70973	64.27304

```

## [81,] 66.83782 56.78082 89.44473 44.47869 64.15740 105.68697 113.50208
## [82,] 73.42932 100.90254 88.87330 99.50367 89.61738 99.47313 64.45334
## [83,] 119.74596 101.35106 131.91548 77.57102 60.94489 108.02903 104.52061
## [84,] 107.20287 120.98694 104.26132 101.48742 80.82496 69.42986 72.90099
## [85,] 66.77673 73.48605 65.03929 90.69824 72.58054 118.85135 76.26073
## [86,] 60.91858 75.85093 79.51106 81.97852 104.05949 73.33718 73.31245
## [87,] 58.08428 101.38680 64.92060 120.27620 110.37359 92.92254 48.46376
## [88,] 107.61864 104.80249 114.75698 71.75155 52.35541 94.73943 86.07369
## [89,] 88.03905 103.76311 97.56241 97.07334 99.09444 67.29331 84.68912
## [90,] 80.07971 94.31147 62.45971 111.58661 87.68410 102.92950 80.73300
## [91,] 77.36708 70.44555 87.15321 82.58103 74.11652 80.81131 68.14715
## [92,] 76.95487 98.08886 66.57074 106.36285 90.61430 100.38712 76.95378
## [93,]      NA 65.47411 58.67412 83.38937 111.90996 103.77464 71.52146
## [94,]      NA      NA 68.21149 68.51139 97.99422 107.83333 110.96789
## [95,]      NA      NA      NA 96.43895 108.18484 86.70430 88.78363
## [96,]      NA      NA      NA      NA 65.07055 82.81860 128.14812
## [97,]      NA      NA      NA      NA      NA 93.44113 99.52958
## [98,]      NA      NA      NA      NA      NA      NA 91.28891
## [99,]      NA      NA      NA      NA      NA      NA      NA
## [100,]      NA      NA      NA      NA      NA      NA      NA
##      [,100]
## [1,] 93.20337
## [2,] 112.96863
## [3,] 46.19553
## [4,] 106.39254
## [5,] 64.51196
## [6,] 89.86099
## [7,] 54.39564
## [8,] 104.68860
## [9,] 74.81951
## [10,] 92.46781
## [11,] 78.36054
## [12,] 96.88925
## [13,] 66.72681
## [14,] 101.22800
## [15,] 83.49191
## [16,] 91.09094
## [17,] 48.91978
## [18,] 96.97408
## [19,] 99.56641
## [20,] 109.69622
## [21,] 55.67242
## [22,] 89.09246
## [23,] 93.21565
## [24,] 74.25652
## [25,] 102.01775
## [26,] 99.98043
## [27,] 87.23477
## [28,] 50.52532
## [29,] 87.64033
## [30,] 91.76510
## [31,] 105.39270
## [32,] 85.85576
## [33,] 89.04099

```

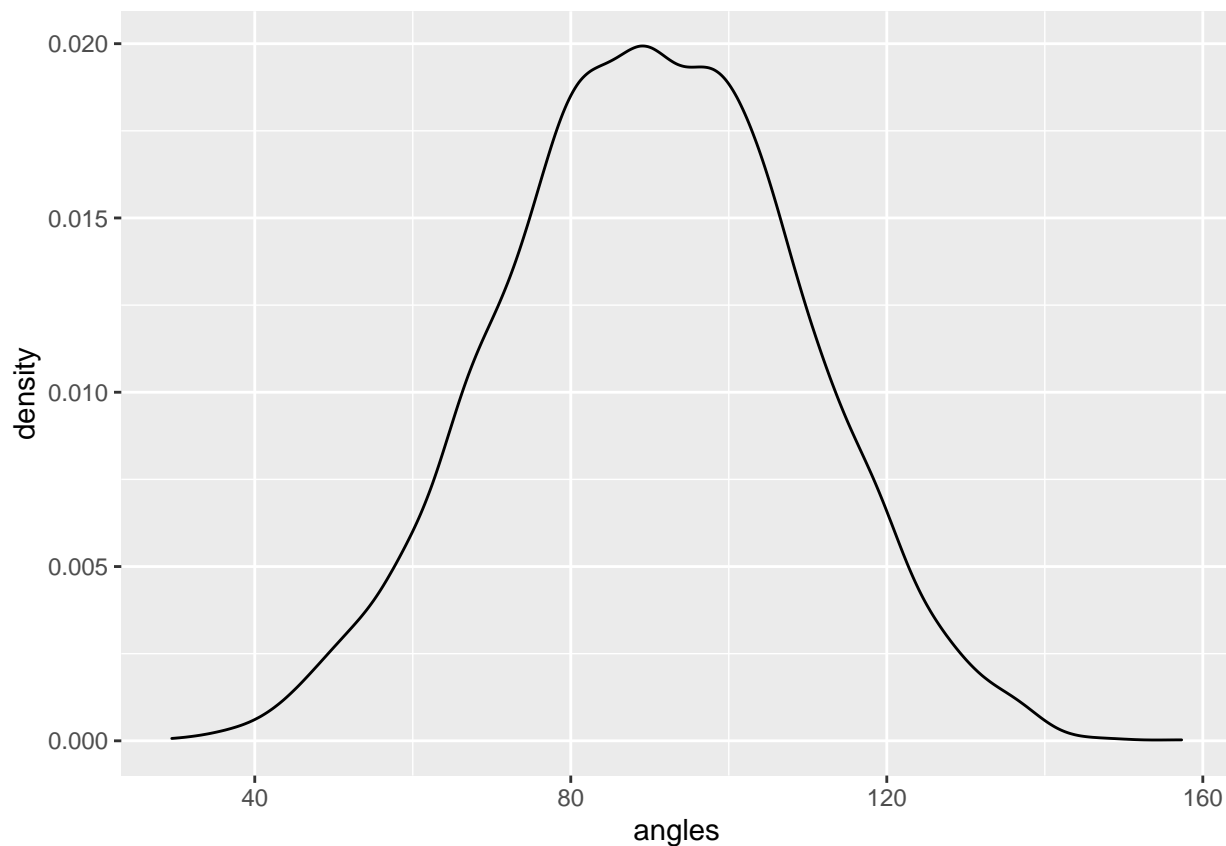
```
## [34,] 94.94424
## [35,] 82.35249
## [36,] 78.30189
## [37,] 122.75900
## [38,] 102.07142
## [39,] 91.77228
## [40,] 94.63885
## [41,] 64.72272
## [42,] 66.26195
## [43,] 67.99517
## [44,] 83.83768
## [45,] 83.34696
## [46,] 123.42785
## [47,] 92.75142
## [48,] 85.40179
## [49,] 60.65522
## [50,] 67.95426
## [51,] 101.79001
## [52,] 88.76318
## [53,] 80.39625
## [54,] 97.96117
## [55,] 92.01491
## [56,] 110.50512
## [57,] 52.53395
## [58,] 94.75845
## [59,] 116.18301
## [60,] 70.08651
## [61,] 101.18392
## [62,] 85.10104
## [63,] 78.59242
## [64,] 73.69590
## [65,] 75.42019
## [66,] 110.18405
## [67,] 63.57099
## [68,] 126.45242
## [69,] 98.26602
## [70,] 74.71129
## [71,] 81.98439
## [72,] 75.82023
## [73,] 117.75988
## [74,] 82.72822
## [75,] 119.01570
## [76,] 107.35808
## [77,] 90.91484
## [78,] 88.16593
## [79,] 89.14007
## [80,] 98.55155
## [81,] 106.26793
## [82,] 115.81771
## [83,] 79.69671
## [84,] 70.54720
## [85,] 111.96420
## [86,] 97.15424
## [87,] 95.24588
```

```
## [88,] 104.31260
## [89,] 103.09260
## [90,] 76.46911
## [91,] 106.36553
## [92,] 102.38959
## [93,] 124.74511
## [94,] 80.75743
## [95,] 92.30907
## [96,] 111.08102
## [97,] 93.95433
## [98,] 90.64328
## [99,] 104.59226
## [100,] NA
```

Plot the density of these angles.

```
pacman::p_load(ggplot2)
ggplot(data.frame(angles=c(all_angles(X)))) +
  aes(x=angles) +
  geom_density()
```

```
## Warning: Removed 5050 rows containing non-finite values (stat_density).
```



Write an Rcpp function `all_angles_cpp` that does the same thing. Use an IDE if you want, but write it below in-line.

```
#cppFunction(
"
  NumericMatrix all_angles_cpp(NumericMatrix X) {
    int n = X.nrow();
    int p = X.ncol();
    NumericMatrix A(n, n);
    std::fill(A.begin(), A.end(), NA_REAL);
    for (int i_1 = 0; i_1 < (n - 1); i_1++){
      for (int i_2 = i_1 + 1; i_2 < n; i_2++){
        double sum_sqd_u = 0;
        double sum_sqd_v = 0;
        double sum_u_v = 0;
        for (int j = 0; j < p; j++){
          sum_sqd_u += pow(X(i_1, j),2);
          sum_sqd_v += pow(X(i_2, j),2);
          sum_u_v += X(i_1, j)* X(i_2, j);
        }
        A(i_1, i_2) = acos(sum_u_v/sqrt(sum_sqd_u*sum_sqd_v)) * (180/ M_PI);
      }
    }
    return A;
  }
"
```

```
## [1] "\n      NumericMatrix all_angles_cpp(NumericMatrix X) {\n      int n = X.nrow();\n      int p = X.ncol();\n"
```

```
#)
#all_angles_cpp(X)
#this code almost destroyed my computer
```

Test the time difference between these functions for $n = 1000$ and $N_{\text{vec}} = 100, 500, 1000, 5000$ using the package `microbenchmark`. Store the results in a matrix with rows representing N_{vec} and two columns for base R and Rcpp.

```
pacman::p_load(microbenchmark)
n<- 1000
N_vec <-100
X= matrix(data=rnorm(Nvec*n),nrow=Nvec)
#microbenchmark(all_angles(X),all_angles_cpp(X),times = 10 )
```

Plot the divergence of performance (in log seconds) over n using a line geometry. Use two different colors for the R and CPP functions. Make sure there's a color legend on your plot. We will see later how to create "long" matrices that make such plots easier.

```
pacman::p_load(ggplot2)
ggplot() + geom_line(aes(y=Nvec, x=log(X), col="microbenchmark")) + geom_line(aes(y=n, x=log(X), col="microbenchmark"))
```

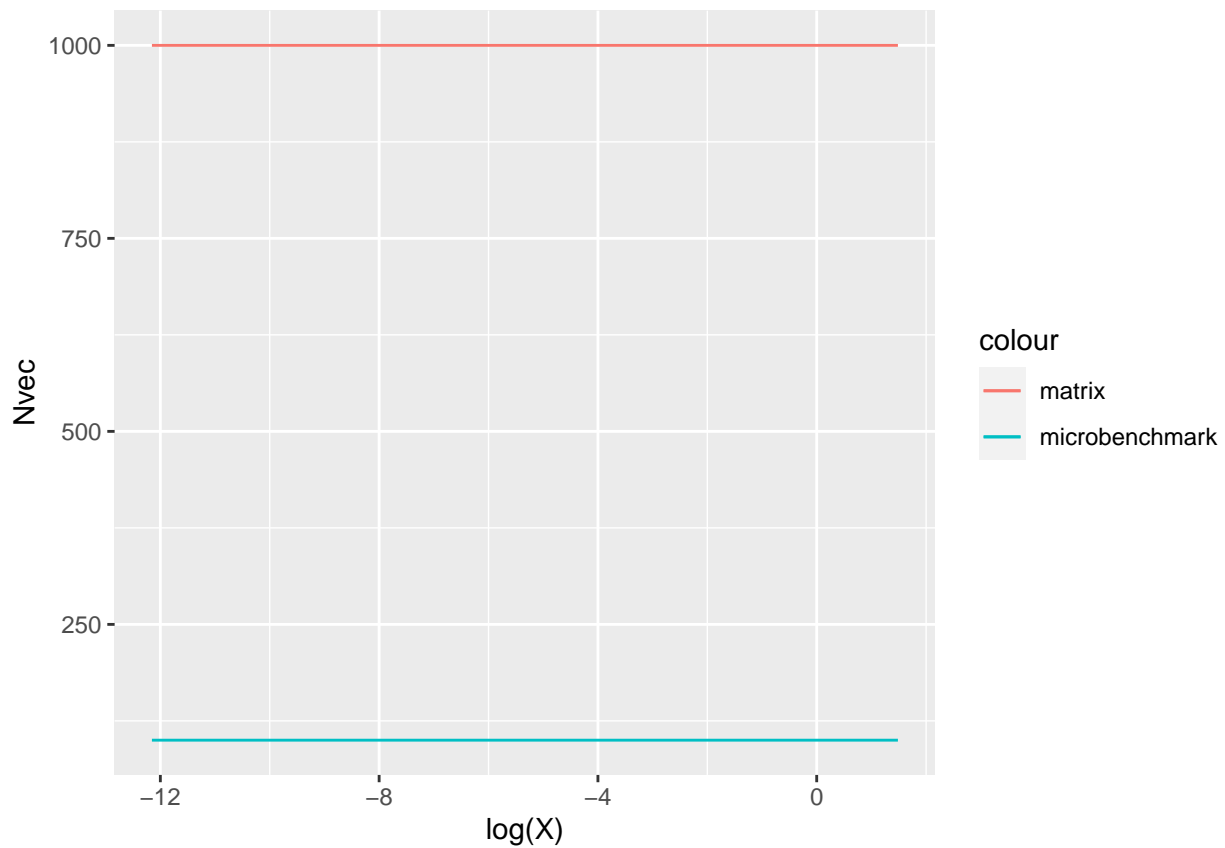
```
## Warning in log(X): NaNs produced
```

```
## Warning in log(X): NaNs produced
```

```
## Warning in log(X): NaNs produced
```

```
## Warning: Removed 50264 row(s) containing missing values (geom_path).
```

```
## Warning: Removed 50264 row(s) containing missing values (geom_path).
```



Let $N_{\text{vec}} = 10000$ and vary n to be 10, 100, 1000. Plot the density of angles for all three values of n on one plot using color to signify n . Make sure you have a color legend. This is not easy.

```
Nvec <- 10000
X <- c()
for (i in 1:10){
  x <- rnorm(Nvec)
  X <- cbind(X, x)
}

#angle1 <- all_angles(X, 10)
#keeps saying unused argument?
X <- c()

for (i in 1:100){
  x <- rnorm(Nvec)
  X <- cbind(X, x)
}

#angle_2 = all_angles(X, 100)
X <- c()

for (i in 1:1000){
```



```

x <- rnorm(Nvec)
X <- cbind(X, x)
}

#angle_3 = all_angles(X, 1000)

#ggplot() + geom_line(aes(x=angle_1, fill = "black"), alpha = 1) + geom_line(aes(x=angle_2, fill = "gre

```

Write an R function `nth_fibonnaci` that finds the `nth` Fibonacci number via recursion but allows you to specify the starting number. For instance, if the sequence started at 1, you get the familiar 1, 1, 2, 3, 5, etc. But if it started at 0.01, you would get 0.01, 0.01, 0.02, 0.03, 0.05, etc.

```

fib <- function(n, t){
  if (n == 1 | n == 2) return (t)
  else return(fib(n-1, t) + fib(n-2, t))
}

```

Write an Rcpp function `nth_fibonnaci_cpp` that does the same thing. Use an IDE if you want, but write it below in-line.

```

#cppFunction(
  'nth_fibonnaci_cpp(n, t){
    if (n == 1 | n == 2) return t;
    else return (nth_fibonacci_cpp(n-1, t) + nth_fibonacci_cpp(n-2, t));
  }
'

```

```

## [1] "nth_fibonnaci_cpp(n, t){\n  if (n == 1 | n == 2) return t;\n  else return (nth_fibonacci_cpp(n-1, t) + nth_fibonacci_cpp(n-2, t));\n}"
#)

```

Time the difference in these functions for `n = 100, 200, ..., 1500` while starting the sequence at the smallest possible floating point value in R. Store the results in a matrix.

```

n = c(1:1500) * 100
time = c()
time_cpp = c()

```

Plot the divergence of performance (in log seconds) over `n` using a line geometry. Use two different colors for the R and CPP functions. Make sure there's a color legend on your plot.

```

#ggplot() + geom_line(aes(y=n, x=log(time), col="time")) + geom_line(aes(y=n, x=log(time_cpp), col="time_cpp"))

```

Data Wrangling / Munging / Carpentry

Throughout this assignment you can use either the `tidyverse` package suite or `data.table` to answer but not base R. You can mix `data.table` with `magrittr` piping if you wish but don't go back and forth between `tbl_df`'s and `data.table` objects.

```
pacman::p_load(dplyr, magrittr, data.table)
```

Load the `storms` dataset from the `dplyr` package and investigate it using `str` and `summary` and `head`. Which two columns should be converted to type factor? Do so below.

```
data(storms)
str(storms)
```

```
## tibble [10,010 x 13] (S3: tbl_df/tbl/data.frame)
##  $ name      : chr [1:10010] "Amy" "Amy" "Amy" "Amy" ...
##  $ year      : num [1:10010] 1975 1975 1975 1975 1975 ...
##  $ month     : num [1:10010] 6 6 6 6 6 6 6 6 6 6 ...
##  $ day       : int [1:10010] 27 27 27 27 28 28 28 28 29 29 ...
##  $ hour      : num [1:10010] 0 6 12 18 0 6 12 18 0 6 ...
##  $ lat       : num [1:10010] 27.5 28.5 29.5 30.5 31.5 32.4 33.3 34 34.4 34 ...
##  $ long      : num [1:10010] -79 -79 -79 -79 -78.8 -78.7 -78 -77 -75.8 -74.8 ...
##  $ status    : chr [1:10010] "tropical depression" "tropical depression" "tropical depression" "trop
##  $ category  : Ord.factor w/ 7 levels "-1"<"0"<"1"<"2"<...: 1 1 1 1 1 1 1 1 1 2 2 ...
##  $ wind      : int [1:10010] 25 25 25 25 25 25 25 30 35 40 ...
##  $ pressure  : int [1:10010] 1013 1013 1013 1013 1012 1012 1011 1006 1004 1002 ...
##  $ ts_diameter: num [1:10010] NA NA NA NA NA NA NA NA NA NA ...
##  $ hu_diameter: num [1:10010] NA NA NA NA NA NA NA NA NA NA ...
```

```
head(storms)
```

```
## # A tibble: 6 x 13
##   name   year month   day hour   lat long status      category wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>      <ord>    <int>    <int>
## 1 Amy    1975     6    27    0  27.5 -79 tropical de~ -1        25     1013
## 2 Amy    1975     6    27    6  28.5 -79 tropical de~ -1        25     1013
## 3 Amy    1975     6    27   12  29.5 -79 tropical de~ -1        25     1013
## 4 Amy    1975     6    27   18  30.5 -79 tropical de~ -1        25     1013
## 5 Amy    1975     6    28    0  31.5 -78.8 tropical de~ -1        25     1012
## 6 Amy    1975     6    28    6  32.4 -78.7 tropical de~ -1        25     1012
## # ... with 2 more variables: ts_diameter <dbl>, hu_diameter <dbl>
```

Reorder the columns so name is first, status is second, category is third and the rest are the same.

```
storms%>%
  select(name,status,category,everything())
```

```
## # A tibble: 10,010 x 13
##   name status      category year month   day hour   lat long wind pressure
##   <chr> <chr>      <ord>    <dbl> <dbl> <int> <dbl> <dbl> <dbl> <int>    <int>
## 1 Amy tropical d~ -1        1975     6    27    0  27.5 -79    25     1013
## 2 Amy tropical d~ -1        1975     6    27    6  28.5 -79    25     1013
## 3 Amy tropical d~ -1        1975     6    27   12  29.5 -79    25     1013
## 4 Amy tropical d~ -1        1975     6    27   18  30.5 -79    25     1013
## 5 Amy tropical d~ -1        1975     6    28    0  31.5 -78.8  25     1012
## 6 Amy tropical d~ -1        1975     6    28    6  32.4 -78.7  25     1012
## 7 Amy tropical d~ -1        1975     6    28   12  33.3 -78    25     1011
```

```
## 8 Amy    tropical d~ -1      1975    6    28    18 34   -77    30    1006
## 9 Amy    tropical s~ 0      1975    6    29    0 34.4 -75.8   35    1004
## 10 Amy   tropical s~ 0      1975    6    29    6 34   -74.8   40    1002
## # ... with 10,000 more rows, and 2 more variables: ts_diameter <dbl>,
## #    hu_diameter <dbl>
```

Find a subset of the data of storms only in the 1970's.

```
storms %>%
  filter(year >= 1970 & year <= 1979)
```

```
## # A tibble: 546 x 13
##   name year month day hour lat long status category wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>    <ord>    <int>    <int>
## 1 Amy    1975    6    27    0 27.5 -79 tropical d~ -1      25    1013
## 2 Amy    1975    6    27    6 28.5 -79 tropical d~ -1      25    1013
## 3 Amy    1975    6    27   12 29.5 -79 tropical d~ -1      25    1013
## 4 Amy    1975    6    27   18 30.5 -79 tropical d~ -1      25    1013
## 5 Amy    1975    6    28    0 31.5 -78.8 tropical d~ -1      25    1012
## 6 Amy    1975    6    28    6 32.4 -78.7 tropical d~ -1      25    1012
## 7 Amy    1975    6    28   12 33.3 -78 tropical d~ -1      25    1011
## 8 Amy    1975    6    28   18 34   -77 tropical d~ -1      30    1006
## 9 Amy    1975    6    29    0 34.4 -75.8 tropical s~ 0      35    1004
## 10 Amy   1975    6    29    6 34   -74.8 tropical s~ 0      40    1002
## # ... with 536 more rows, and 2 more variables: ts_diameter <dbl>,
## #    hu_diameter <dbl>
```

Find a subset of the data of storm observations only with category 4 and above and wind speed 100MPH and above.

```
storms %>%
  filter(category >= 4 & wind >= 100)
```

```
## # A tibble: 416 x 13
##   name year month day hour lat long status category wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>    <ord>    <int>    <int>
## 1 Anita  1977    9    2    0 24.6 -96.2 hurricane 5      140    931
## 2 Anita  1977    9    2    6 24.2 -97.1 hurricane 5      150    926
## 3 Anita  1977    9    2   12 23.7 -98 hurricane 4      120    940
## 4 David  1979    8   28    0 12.2 -52.9 hurricane 4      115    947
## 5 David  1979    8   28    6 12.5 -54.4 hurricane 4      125    941
## 6 David  1979    8   28   12 12.8 -55.7 hurricane 4      130    938
## 7 David  1979    8   28   18 13.2 -56.9 hurricane 4      125    941
## 8 David  1979    8   29    0 13.7 -58 hurricane 4      120    944
## 9 David  1979    8   29    6 14.2 -59.2 hurricane 4      120    942
## 10 David 1979    8   29   12 14.8 -60.3 hurricane 4      125    938
## # ... with 406 more rows, and 2 more variables: ts_diameter <dbl>,
## #    hu_diameter <dbl>
```

Create a new feature wind_speed_per_unit_pressure.

```
storms %>%
  mutate(wind_speed_per_unit_pressure = wind /pressure)
```

```
## # A tibble: 10,010 x 14
##   name   year month   day hour   lat   long status   category wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>      <ord>    <int>    <int>
## 1 Amy    1975     6    27     0  27.5 -79   tropical d~ -1      25     1013
## 2 Amy    1975     6    27     6  28.5 -79   tropical d~ -1      25     1013
## 3 Amy    1975     6    27    12  29.5 -79   tropical d~ -1      25     1013
## 4 Amy    1975     6    27    18  30.5 -79   tropical d~ -1      25     1013
## 5 Amy    1975     6    28     0  31.5 -78.8 tropical d~ -1      25     1012
## 6 Amy    1975     6    28     6  32.4 -78.7 tropical d~ -1      25     1012
## 7 Amy    1975     6    28    12  33.3 -78   tropical d~ -1      25     1011
## 8 Amy    1975     6    28    18  34   -77   tropical d~ -1      30     1006
## 9 Amy    1975     6    29     0  34.4 -75.8 tropical s~ 0       35     1004
## 10 Amy   1975     6    29     6  34   -74.8 tropical s~ 0       40     1002
## # ... with 10,000 more rows, and 3 more variables: ts_diameter <dbl>,
## #   hu_diameter <dbl>, wind_speed_per_unit_pressure <dbl>
```

Create a new feature: `average_diameter` which averages the two diameter metrics. If one is missing, then use the value of the one that is present. If both are missing, leave missing.

```
storms %>%
  rowwise() %>%
  arrange(desc(year)) %>%
  mutate (average_diamter= mean (c(ts_diameter,hu_diameter),na.rm=TRUE))
```

```
## # A tibble: 10,010 x 14
## # Rowwise:
##   name   year month   day hour   lat   long status   category wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>      <ord>    <int>    <int>
## 1 Ana    2015     5     9     6  32.2 -77.5 tropical s~ 0       50     998
## 2 Ana    2015     5     9    12  32.5 -77.8 tropical s~ 0       50    1001
## 3 Ana    2015     5     9    18  32.7 -78   tropical s~ 0       45    1001
## 4 Ana    2015     5    10     0  33.1 -78.3 tropical s~ 0       45    1001
## 5 Ana    2015     5    10     6  33.5 -78.6 tropical s~ 0       40    1002
## 6 Ana    2015     5    10    10  33.8 -78.8 tropical s~ 0       40    1002
## 7 Ana    2015     5    10    12  33.9 -78.8 tropical s~ 0       35    1002
## 8 Ana    2015     5    10    18  34.3 -78.7 tropical d~ -1      30    1006
## 9 Ana    2015     5    11     0  34.7 -78.5 tropical d~ -1      30    1009
## 10 Ana   2015     5    11     6  35.5 -78   tropical d~ -1      30    1010
## # ... with 10,000 more rows, and 3 more variables: ts_diameter <dbl>,
## #   hu_diameter <dbl>, average_diamter <dbl>
```

For each storm, summarize the maximum wind speed. “Summarize” means create a new dataframe with only the summary metrics you care about.

```
storms %>%
  group_by(name) %>%
  summarise(max_wind_speed= max(wind,na.rm=TRUE))
```

```
## # A tibble: 198 x 2
##   name      max_wind_speed
##   <chr>          <int>
## 1 AL011993         30
## 2 AL012000         25
## 3 AL021992         30
## 4 AL021994         30
## 5 AL021999         30
## 6 AL022000         30
## 7 AL022001         25
## 8 AL022003         30
## 9 AL022006         45
## 10 AL031987        40
## # ... with 188 more rows
```

Order your dataset by maximum wind speed storm but within the rows of storm show the observations in time order from early to late.

```
storms %>%
  group_by(name) %>%
  mutate(max_wind_by_storm = max(wind, na.rm = TRUE)) %>%
  select(name, max_wind_by_storm, everything()) %>%
  arrange(desc(max_wind_by_storm), year, month, day, hour)
```

```
## # A tibble: 10,010 x 14
## # Groups:   name [198]
##   name      max_wind_by_sto~ year month   day hour   lat long status category
##   <chr>          <int> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>   <ord>
## 1 Gilbe~         160  1988     9     8    18  12   -54  tropica~ -1
## 2 Gilbe~         160  1988     9     9     0 12.7 -55.6  tropica~ -1
## 3 Gilbe~         160  1988     9     9     6 13.3 -57.1  tropica~ -1
## 4 Gilbe~         160  1988     9     9    12  14   -58.6  tropica~ -1
## 5 Gilbe~         160  1988     9     9    18 14.5 -60.1  tropica~  0
## 6 Gilbe~         160  1988     9    10     0 14.8 -61.5  tropica~  0
## 7 Gilbe~         160  1988     9    10     6  15   -62.8  tropica~  0
## 8 Gilbe~         160  1988     9    10    12 15.3 -64.1  tropica~  0
## 9 Gilbe~         160  1988     9    10    18 15.7 -65.4  tropica~  0
## 10 Gilbe~         160  1988     9    11     0 15.9 -66.8  hurrica~  1
## # ... with 10,000 more rows, and 4 more variables: wind <int>, pressure <int>,
## #   ts_diameter <dbl>, hu_diameter <dbl>
```

Find the strongest storm by wind speed per year.

```
storms %>%
  group_by(year) %>%
  arrange(year, desc(wind)) %>%
  slice(1)
```

```
## # A tibble: 41 x 13
## # Groups:   year [41]
##   name      year month   day hour   lat long status category wind pressure
##   <chr>    <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>   <ord>    <int>    <int>
```

```
## 1 Caroline 1975      8    31      0 24   -97   hurrica~ 3          100      973
## 2 Belle    1976      8     9      0 30.9 -75.3 hurrica~ 3          105      957
## 3 Anita    1977      9     2      6 24.2 -97.1 hurrica~ 5          150      926
## 4 Cora     1978      8     9      0 14   -44.9 hurrica~ 1           80      980
## 5 David    1979      8    30     18 16.6 -66.2 hurrica~ 5          150      924
## 6 Ivan     1980     10     6     18 28.1 -31.1 hurrica~ 2           90      970
## 7 Harvey   1981      9    15      0 28.4 -62.6 hurrica~ 4          115      946
## 8 Debby    1982      9    18      0 38.8 -62.3 hurrica~ 4          115      950
## 9 Alicia   1983      8    18      6 28.9 -95   hurrica~ 3          100      963
## 10 Diana   1984      9    12      0 33.9 -77.7 hurrica~ 4          115      949
## # ... with 31 more rows, and 2 more variables: ts_diameter <dbl>,
## #   hu_diameter <dbl>
```

For each named storm, find its maximum category, wind speed, pressure and diameters. Do not allow the max to be NA (unless all the measurements for that storm were NA).

```
storms %>%
  group_by(name) %>% summarise(max_category = max(category),
                              max_windspeed = max(wind),
                              max_pressure = max(pressure),
                              max_diam_ts = max(ts_diameter),
                              max_diam_hu = max(hu_diameter)) %>% na.omit()
```

```
## # A tibble: 54 x 6
##   name      max_category max_windspeed max_pressure max_diam_ts max_diam_hu
##   <chr>      <ord>          <int>         <int>      <dbl>      <dbl>
## 1 AL022006  0                45          1008        69.0         0
## 2 AL102004 -1                30          1013         0           0
## 3 AL202011  0                40          1011        69.0         0
## 4 Andrea    0                55          1006        207.         0
## 5 Beta      3               100          1007        127.        34.5
## 6 Colin     0                50          1013        104.         0
## 7 Don       0                45          1007        69.0         0
## 8 Dorian    0                50          1013        80.6         0
## 9 Eight     -1                30          1009         0           0
## 10 Epsilon  1                75          1005        276.        63.3
## # ... with 44 more rows
```

For each year in the dataset, tally the number of storms. “Tally” is a fancy word for “count the number of”. Plot the number of storms by year. Any pattern?

```
data(storms)
storms %>%
  group_by(year) %>% summarize(num_storms = n_distinct(name))
```

```
## # A tibble: 41 x 2
##   year num_storms
##   <dbl>     <int>
## 1 1975         3
## 2 1976         2
## 3 1977         3
## 4 1978         4
```

```
## 5 1979      7
## 6 1980      8
## 7 1981      5
## 8 1982      5
## 9 1983      4
## 10 1984     10
## # ... with 31 more rows
```

For each year in the dataset, tally the storms by category.

```
storms %>% group_by(year, category) %>% summarise(storms = n())
```

‘summarise()’ has grouped output by ‘year’. You can override using the ‘.groups’ argument.

```
## # A tibble: 233 x 3
## # Groups:   year [41]
##   year category storms
##   <dbl> <ord>    <int>
## 1 1975 -1         30
## 2 1975 0         33
## 3 1975 1         12
## 4 1975 2          9
## 5 1975 3          2
## 6 1976 -1        10
## 7 1976 0        20
## 8 1976 1        10
## 9 1976 2          9
## 10 1976 3          3
## # ... with 223 more rows
```

For each year in the dataset, find the maximum wind speed per status level.

```
storms %>% group_by(year, status) %>% summarise(maxwind = max(wind))
```

‘summarise()’ has grouped output by ‘year’. You can override using the ‘.groups’ argument.

```
## # A tibble: 123 x 3
## # Groups:   year [41]
##   year status      maxwind
##   <dbl> <chr>         <int>
## 1 1975 hurricane      100
## 2 1975 tropical depression  30
## 3 1975 tropical storm     60
## 4 1976 hurricane     105
## 5 1976 tropical depression  30
## 6 1976 tropical storm     60
## 7 1977 hurricane     150
## 8 1977 tropical depression  30
## 9 1977 tropical storm     60
## 10 1978 hurricane      80
## # ... with 113 more rows
```

For each storm, summarize its average location in latitude / longitude coordinates.

```
storms %>% group_by(name) %>% summarise(lats = mean(lat), long = mean(long))
```

```
## # A tibble: 198 x 3
##   name      lats long
##   <chr>    <dbl> <dbl>
## 1 AL011993 24.7  -78.0
## 2 AL012000 20.8  -93.1
## 3 AL021992 26.7  -84.5
## 4 AL021994 33.6  -79.7
## 5 AL021999 20.4  -96.4
## 6 AL022000  9.9  -28.5
## 7 AL022001 11.9  -45.3
## 8 AL022003  9.62 -43.4
## 9 AL022006 41.3  -63.5
## 10 AL031987 30.8  -88.7
## # ... with 188 more rows
```

For each storm, summarize its duration in number of hours (to the nearest 6hr increment).

```
storms %>% group_by(name) %>% summarise(duration = (hour) %% 6 == 0)
```

'summarise()' has grouped output by 'name'. You can override using the '.groups' argument.

```
## # A tibble: 10,010 x 2
## # Groups:   name [198]
##   name      duration
##   <chr>    <lgl>
## 1 AL011993 TRUE
## 2 AL011993 TRUE
## 3 AL011993 TRUE
## 4 AL011993 TRUE
## 5 AL011993 TRUE
## 6 AL011993 TRUE
## 7 AL011993 TRUE
## 8 AL011993 TRUE
## 9 AL012000 TRUE
## 10 AL012000 TRUE
## # ... with 10,000 more rows
```

For storm in a category, create a variable `storm_number` that enumerates the storms 1, 2, ... (in date order).

```
#storms %>%
#  storm_number <- c(, range(1:length(storms)))
```

Convert year, month, day, hour into the variable `timestamp` using the `lubridate` package. Although the new package `clock` just came out, `lubridate` still seems to be standard. Next year I'll probably switch the class to be using `clock`.


```
pacman::p_load(lubridate)
storms %>% mutate(timestamp = c(paste(year, month, day, hour, sep = "-")))
```

```
## # A tibble: 10,010 x 14
##   name year month day hour lat long status category wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>      <ord>    <int>    <int>
## 1 Amy  1975 6 27 0 27.5 -79 tropical d~ -1 25 1013
## 2 Amy  1975 6 27 6 28.5 -79 tropical d~ -1 25 1013
## 3 Amy  1975 6 27 12 29.5 -79 tropical d~ -1 25 1013
## 4 Amy  1975 6 27 18 30.5 -79 tropical d~ -1 25 1013
## 5 Amy  1975 6 28 0 31.5 -78.8 tropical d~ -1 25 1012
## 6 Amy  1975 6 28 6 32.4 -78.7 tropical d~ -1 25 1012
## 7 Amy  1975 6 28 12 33.3 -78 tropical d~ -1 25 1011
## 8 Amy  1975 6 28 18 34 -77 tropical d~ -1 30 1006
## 9 Amy  1975 6 29 0 34.4 -75.8 tropical s~ 0 35 1004
## 10 Amy 1975 6 29 6 34 -74.8 tropical s~ 0 40 1002
## # ... with 10,000 more rows, and 3 more variables: ts_diameter <dbl>,
## # hu_diameter <dbl>, timestamp <chr>
```

Using the lubridate package, create new variables `day_of_week` which is a factor with levels “Sunday”, “Monday”, ... “Saturday” and `week_of_year` which is integer 1, 2, ..., 52.

```
#storms %<% c(day_of_week = weekdays(timestamp), week_of_year = week(timestamp))
```

For each storm, summarize the day in which is started in the following format “Friday, June 27, 1975”.

```
#storms %>% group_by(name) %>% summarise(date = min(timestamp)) %>%
#  #c(date = paste(weekdays(date), paste(months(date), day(date), sep = " "),
#    #year(date), sep = ""))
```

Create a new factor variable `decile_windspeed` by binning wind speed into 10 bins.

```
bins = range(0:10)
storms %<>% mutate(decile_windspeed = factor(cut(wind, breaks = quantile(wind, bins/10), labels = FALSE,
```

Create a new data frame `serious_storms` which are category 3 and above hurricanes.

```
serious_storms = storms %>% filter(category > 3)
```

In `serious_storms`, merge the variables `lat` and `long` together into `lat_long` with values `lat / long` as a string.

```
serious_storms %<>% mutate(lat_long = paste(lat, long, sep = " "))
```

Let's return now to the original `storms` data frame. For each category, find the average wind speed, pressure and diameters (do not count the NA's in your averaging).

```
storms %>% group_by(lat) %>% summarise(average_wind=mean(wind), average_pressure = mean(pressure))
```

```
## # A tibble: 403 x 3
##   lat average_wind average_pressure
##   <dbl>         <dbl>         <dbl>
## 1  7.2          25          1010
## 2  7.4          25          1010
## 3  8.3          30          1009
## 4  8.4         27.5          1009
## 5  8.6          25          1008
## 6  8.8          25          1010
## 7  8.9         37.5          1004.
## 8  9           36.7          1003
## 9  9.1          35          1004.
## 10 9.2         27.5          1009.
## # ... with 393 more rows
```

```
storms %>% group_by(long) %>% summarise(average_wind=mean(wind), average_pressure = mean(pressure))
```

```
## # A tibble: 856 x 3
##   long average_wind average_pressure
##   <dbl>         <dbl>         <dbl>
## 1 -109.          20          1008
## 2 -109.          20          1008
## 3 -109.          20          1008
## 4 -109.          25          1008
## 5 -109.          25          1007
## 6 -108.          25          1007
## 7 -108.          25          1007
## 8 -108.          25          1006
## 9 -108.          25          1006
## 10 -107.         25          1005
## # ... with 846 more rows
```

For each named storm, find its maximum category, wind speed, pressure and diameters (do not allow the max to be NA) and the number of readings (i.e. observations).

```
storms %>% group_by(name) %>% summarise(max_wind=max(wind), max_pressure = max(pressure),
                                         max_diam_ts = max(ts_diameter), max_diam_hu = max(hu_diameter))
```

```
## # A tibble: 198 x 5
##   name      max_wind max_pressure max_diam_ts max_diam_hu
##   <chr>         <int>         <int>         <dbl>         <dbl>
## 1 AL011993      30          1003          NA          NA
## 2 AL012000      25          1010          NA          NA
## 3 AL021992      30          1009          NA          NA
## 4 AL021994      30          1017          NA          NA
## 5 AL021999      30          1006          NA          NA
## 6 AL022000      30          1010          NA          NA
## 7 AL022001      25          1012          NA          NA
## 8 AL022003      30          1010          NA          NA
## 9 AL022006      45          1008          69.0          0
## 10 AL031987      40          1015          NA          NA
## # ... with 188 more rows
```

Calculate the distance from each storm observation to Miami in a new variable `distance_to_miami`. This is very challenging. You will need a function that computes distances from two sets of latitude / longitude coordinates.

```
MIAMI_LAT_LONG_COORDS = c(25.7617, -80.1918)
#TO-DO
```

For each storm observation, use the function from the previous question to calculate the distance it moved since the previous observation.

```
#TO-DO
```

For each storm, find the total distance it moved over its observations and its total displacement. “Distance” is a scalar quantity that refers to “how much ground an object has covered” during its motion. “Displacement” is a vector quantity that refers to “how far out of place an object is”; it is the object’s overall change in position.

```
#TO-DO
```

For each storm observation, calculate the average speed the storm moved in location.

```
#TO-DO
```

For each storm, calculate its average ground speed (how fast its eye is moving which is different from windspeed around the eye).

```
#TO-DO
```

Is there a relationship between average ground speed and maximum category attained? Use a dataframe summary (not a regression).

```
#TO-DO
```

Now we want to transition to building real design matrices for prediction. This is more in tune with what happens in the real world. Large data dump and you convert it into X and y how you see fit.

Suppose we wish to predict the following: given the first three readings of a storm, can you predict its maximum wind speed? Identify the y and identify which features you need x_1, \dots, x_p and build that matrix with `dplyr` functions. This is not easy, but it is what it’s all about. Feel free to “featurize” as creatively as you would like. You aren’t going to overfit if you only build a few features relative to the total 198 storms.

```
storms %>% group_by(name) %>% summarise(x = max(wind), max_pressure = max(pressure))
```

```
## # A tibble: 198 x 3
##   name      x max_pressure
##   <chr>  <int>      <int>
## 1 AL011993  30        1003
## 2 AL012000  25        1010
## 3 AL021992  30        1009
## 4 AL021994  30        1017
## 5 AL021999  30        1006
## 6 AL022000  30        1010
```

```
## 7 AL022001 25 1012
## 8 AL022003 30 1010
## 9 AL022006 45 1008
## 10 AL031987 40 1015
## # ... with 188 more rows
```

Fit your model. Validate it.

Assess your level of success at this endeavor.

#TO-DO

The Forward Stepwise Procedure for Probability Estimation Models

Set a seed and load the `adult` dataset and remove missingness and randomize the order.

```
set.seed(1)
pacman::p_load_gh("coatless/ucidata")
data(adult)
adult = na.omit(adult)
adult = adult[sample(1 : nrow(adult)), ]
```

Copy from the previous lab all cleanups you did to this dataset.

#TO-DO

We will be doing model selection. We will split the dataset into 3 distinct subsets. Set the size of our splits here. For simplicity, all three splits will be identically sized. We are making it small so the stepwise algorithm can compute quickly. If you have a faster machine, feel free to increase this.

```
Nsplitsize = 1000
```

Now create the following variables: `Xtrain`, `ytrain`, `Xselect`, `yselect`, `Xtest`, `ytest` with `Nsplitsize` observations. Binarize the `y` values.

```
Xtrain = adult[1 : Nsplitsize, ]
Xtrain$income = NULL
ytrain = ifelse(adult[1 : Nsplitsize, "income"] == ">50K", 1, 0)
Xselect = adult[(Nsplitsize + 1) : (2 * Nsplitsize), ]
Xselect$income = NULL
yselect = ifelse(adult[(Nsplitsize + 1) : (2 * Nsplitsize), "income"] == ">50K", 1, 0)
Xtest = adult[(2 * Nsplitsize + 1) : (3 * Nsplitsize), ]
Xtest$income = NULL
ytest = ifelse(adult[(2 * Nsplitsize + 1) : (3 * Nsplitsize), "income"] == ">50K", 1, 0)
```

Fit a vanilla logistic regression on the training set.

```
logistic_mod = glm(ytrain ~ ., Xtrain, family = "binomial")
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

and report the log scoring rule, the Brier scoring rule.

```
#TO-DO
```

We will be doing model selection using a basis of linear features consisting of all first-order interactions of the 14 raw features (this will include square terms as squares are interactions with oneself).

Create a model matrix from the training data containing all these features. Make sure it has an intercept column too (the one vector is usually an important feature). Cast it as a data frame so we can use it more easily for modeling later on. We're going to need those model matrices (as data frames) for both the select and test sets. So make them here too (copy-paste). Make sure their dimensions are sensible.

```
#TO-DO  
#dim(Xmm_train)  
#dim(Xmm_select)  
#dim(Xmm_test)
```

Write code that will fit a model stepwise. You can refer to the chunk in the practice lecture. Use the negative Brier score to do the selection. The negative of the Brier score is always positive and lower means better making this metric kind of like `s_e` so the picture will be the same as the canonical U-shape for oos performance.

Run the code and hit “stop” when you begin to see the Brier score degrade appreciably oos. Be patient as it will wobble.

```
pacman::p_load(Matrix)  
#p_plus_one = ncol(Xmm_train)  
predictor_by_iteration = c() #keep a growing list of predictors by iteration  
in_sample_brier_by_iteration = c() #keep a growing list of briers by iteration  
oos_brier_by_iteration = c() #keep a growing list of briers by iteration  
i = 1  
  
#repeat {  
  
  #TO-DO  
  #wrap glm and predict calls with use suppressWarnings() so the console is clean during run  
  
  #if (i > Nsplitsize || i > p_plus_one){  
    # break  
  # }  
  #}
```

Plot the in-sample and oos (select set) Brier score by p . Does this look like what's expected?

```
#TO-DO
```