

# R 입문 기말고사

김남윤(202121204)

12/21/2021

1번

1-(1)번

```
epsilon_i<-rnorm(1000)
epsilon_i
```

```
##      [1] -0.1912778996  0.4460940973  0.4603615533 -0.9213330041  1.2927464113
##      [6]  0.4436096948 -1.3872971826 -0.8543770406  1.3316680307  1.5948818159
##     [11]  0.8233523884  0.8122457901  0.8379790503 -0.8603361473  1.6933644380
##     [16]  0.1679607290 -1.3376849749 -0.3887080890 -0.9367976985  0.5928838504
##     [21]  0.7026103028 -0.0770103562  2.8432860396 -1.9361091178  1.0559851145
##     [26]  1.0025170688 -0.1782598671  0.5447902068 -0.5880605097 -1.6400069954
##     [31]  0.0545236711 -1.1780247203 -0.4157179775 -0.0333373940  0.2622443000
##     [36] -0.3414256318 -1.3505801760 -0.5253953857  0.4920448874 -1.8067660732
##     [41]  2.1828407753 -0.2963455603 -0.0789459854  0.9305957734 -0.5151020741
##     [46] -0.5850832293  1.6855704456  1.8534915842 -0.6918117943  1.7574784327
##     [51]  1.1655935350 -0.6859855997  0.1303996839  0.2164442666 -0.9532829298
##     [56]  0.0499805651  1.9833578203 -1.3045737007 -0.0686590680  2.1065420956
##     [61]  0.4557942443 -0.2329654092 -0.7836142006  1.6614748899 -0.0194754199
##     [66]  0.3035984878 -0.1939659328  0.3049997604  0.2370060597  0.7968959430
##     [71] -0.6025300366  0.4212081004  0.4153567414 -2.0121155667 -0.5669219493
##     [76] -0.3592929974 -1.5034131142 -0.9407657020 -0.2999739670 -0.8606619806
##     [81]  2.4279176352 -1.3525808043  0.4643710299 -0.8402163269  0.3360661499
##     [86] -0.1122483829 -0.1114760571  0.0812960432 -0.0584032123  0.1786173183
##     [91] -1.9075063348 -0.8410719841 -0.4282458460  0.7978058440  0.2256194617
##     [96] -0.4153236093 -1.6140586978  0.9118023638  0.5405530351 -0.3931785471
##    [101]  0.0382813798 -0.4025359955  2.3054659169 -1.2247937624  0.6822671816
##    [106]  1.8242882790 -0.2466954566  1.1811004423  0.4626511805  1.7789575866
##    [111]  0.5404487663  1.6210331553  0.2296557009  2.0430644739 -0.1042722055
##    [116]  0.1250975082 -1.7040186882  0.2654789079 -1.1042572320 -1.1792869891
##    [121]  1.0379516229  1.3328385070 -0.6016743616 -2.0279498640 -0.7891425419
##    [126] -0.6664483477  2.0358136896 -0.4561437643 -1.2993993729  0.0914361027
```

##	[131]	0.1894745029	0.3450643923	1.3839817160	1.1432445820	0.3022523508
##	[136]	0.3703820076	-0.5146188683	0.7878269113	1.0325910168	0.6653049169
##	[141]	-0.3366419016	0.9501329540	0.3105854032	-0.0892395747	-1.3994002549
##	[146]	-0.3094613610	-1.2377868682	0.2261673613	-0.9771046752	1.4479768891
##	[151]	-0.7903092808	-0.9473763008	0.1136895476	0.4808422102	0.3678631423
##	[156]	-1.2603129716	-0.1411049481	0.4008888818	-0.0646274684	0.9112688603
##	[161]	-0.3338464858	0.0548161142	0.8647511614	-0.1159098990	-0.5151656813
##	[166]	-0.0398910707	0.6011698743	-1.3399010310	-0.9663746942	-1.2979704925
##	[171]	0.0399001083	1.9017310358	1.1713060563	-0.6474816243	0.7424861726
##	[176]	-0.3667235718	-0.7864274934	0.0699796275	1.2618687582	-1.4769295444
##	[181]	-0.9062166113	0.2962651532	-1.1996375060	0.1806811894	-0.9939579083
##	[186]	-1.7161020180	0.4852518257	0.2006109465	0.5142488799	-1.3838805971
##	[191]	-0.1441572197	-0.0522748843	-0.4455959101	1.4310260974	0.4373936626
##	[196]	-0.8096255387	1.1265908043	1.2688085651	0.5277228560	0.3496973099
##	[201]	0.7784650838	0.1896114188	0.1638543427	-0.9413500503	0.1106099492
##	[206]	1.2618208303	-2.4341517124	-0.8406001634	0.1259590792	0.0011642137
##	[211]	0.3940040165	0.7708792349	0.1183106010	0.1172806034	0.6727342113
##	[216]	-1.0820689108	0.5546615798	0.1908039500	0.8033247776	-0.3720727811
##	[221]	-0.4466056371	1.8006200133	0.5071454132	-0.6985842430	-0.5175108002
##	[226]	1.2982557793	-2.2156852516	-0.9931016606	0.9246328264	-0.3881763162
##	[231]	0.2218031017	-0.8717515888	1.0812048009	-0.1097212107	0.1702903124
##	[236]	-0.0081095114	1.4870822384	-0.4383899195	-0.7962919020	2.5798909339
##	[241]	-0.6730017562	-1.1990965307	0.6074239644	0.2656659698	-0.8755531168
##	[246]	0.7659107492	0.5969627500	1.5563666481	-0.9793538179	0.6855713191
##	[251]	2.0121849265	-0.3795815354	-0.7484900982	0.1358677861	-0.6552372450
##	[256]	0.0149909211	0.8609989929	2.1523599536	1.1928294278	0.1492553005
##	[261]	-2.0617872818	-0.1034106292	-0.2131713876	-0.1189346930	-0.2932057479
##	[266]	-0.2062691670	-0.5973783094	0.8233202350	0.6098685915	0.3510951787
##	[271]	1.0396344342	-0.7403267339	1.7451855232	0.5966433138	0.8093491429
##	[276]	-0.5277263687	-0.5238233100	0.6071020905	-0.3403120696	-0.3914918361
##	[281]	-0.5159916742	0.3894729082	0.4652494337	0.5978595447	-0.3809287368
##	[286]	0.7520979177	1.1051998922	2.1322342511	-0.1199876413	1.5521635117
##	[291]	-1.2933935058	-0.2759455373	0.3922910125	0.5740739766	0.2202243451
##	[296]	-0.2151259493	0.1888366003	0.3986437070	-0.1595209794	-0.1220802298
##	[301]	0.9485513184	-1.3949283489	0.4073482844	2.9176605126	-0.0104564697
##	[306]	0.4242992046	-0.1133411473	0.1709257038	-0.2647475712	0.8240399263
##	[311]	-0.6255891177	-0.1877394369	1.0976182438	-0.8847560511	1.6190987420
##	[316]	-0.5188150065	-1.1441772551	-0.1243725563	-1.5094579696	0.0090276637
##	[321]	-0.5517253901	0.3977701197	1.5458973810	-0.0904540009	-0.4503174650
##	[326]	1.0423515312	0.6877497904	0.5223431027	-0.9940512048	-0.4069923979
##	[331]	0.9310390868	0.6971493723	-0.6526187164	-1.9607075694	-0.5861385286
##	[336]	0.1360001926	-0.9375847645	-0.7447609395	1.2207572513	1.9364097880
##	[341]	-0.6339989288	-0.3949988340	0.5686556228	1.2523289006	-0.0792886994
##	[346]	-0.0070981091	-0.4483845312	1.4312212112	0.0086218937	-0.6702159005
##	[351]	0.5678380974	-1.1597682265	-0.4587750948	0.2871742049	-0.9840794968

##	[356]	1.7542956211	-0.3829937729	-0.8207337820	-0.0001177968	0.6084051907
##	[361]	0.2422214111	-0.3570845788	-1.0834619906	1.0123895192	-1.5086052631
##	[366]	0.9737725785	-0.6464223823	0.2590912053	1.2790387907	-0.4620144995
##	[371]	1.0356254075	-1.0298989402	0.6383123495	-0.2175274947	-2.6836611719
##	[376]	1.1205861056	-1.3859212807	0.7956945051	0.0183521044	1.6860608426
##	[381]	1.0727937600	-0.7476433548	0.1306253624	0.0053714485	2.2850787666
##	[386]	-1.0820943045	0.5905600354	1.4475600217	-0.7747863523	0.1705699464
##	[391]	-0.5847113392	-2.6073687861	-0.1325875023	1.6606073802	-0.5178879730
##	[396]	-0.2402756377	-0.5025758877	-2.1970449106	0.3362799328	-1.9415156989
##	[401]	1.6176787464	-0.6870268483	1.2183991434	-1.6898582399	-1.3759084108
##	[406]	-0.2384751756	0.1744282373	-1.4286452119	0.6472146528	0.9823403503
##	[411]	1.1623920861	-0.9477396706	-0.0559531174	-1.1693401510	-1.9368552757
##	[416]	-0.1593217790	-0.0813153348	-0.9198187133	-0.7675844302	0.3823918393
##	[421]	1.7907402500	-0.1444269331	-0.0552122471	-0.5907691619	0.3298803574
##	[426]	-1.2596326153	0.9484468365	0.7048499118	-1.0928735654	0.6190026761
##	[431]	-0.2879747536	0.9633995880	-1.6825834742	0.0150188496	0.7121251465
##	[436]	1.0299363449	-0.0074507808	1.4600980903	-1.0589954941	-1.7481312388
##	[441]	-1.3101282183	-0.5848221405	-1.1187277262	0.8165548559	0.6350955991
##	[446]	-1.0180578637	1.6247846749	0.1842970171	0.8127006889	0.6156453065
##	[451]	-1.0678688089	-1.1089095682	-1.0319926326	-0.7805232421	0.4559998528
##	[456]	1.5572066447	-0.7027434781	-0.0830188871	-0.6415702630	1.2484384539
##	[461]	-0.3146781391	-1.6045510501	-2.1925965776	-0.2651910725	0.8866744833
##	[466]	-0.4434252899	-0.3914093466	1.1998563771	-0.9744920970	-0.7926794800
##	[471]	-0.2223450048	1.0180988741	-1.1098920755	-0.3848040814	-0.6361545593
##	[476]	-0.3542806507	-0.7733478876	-1.0451038173	0.6689386975	-1.2044305375
##	[481]	0.1821264111	-0.6060273530	0.1999135765	-0.2376835942	-0.8357946418
##	[486]	-1.8274246466	0.5716436751	-0.6705901169	0.2455188118	0.0235129190
##	[491]	-0.5936533664	-0.0988366655	-0.6031572122	0.8501180946	0.1179626823
##	[496]	0.9025748186	0.2621318734	-0.0932814353	-0.4947449056	-0.9747552453
##	[501]	0.2149471102	-0.0908740560	-0.6654647120	0.1809348889	1.8993795556
##	[506]	0.4113516787	0.7900452097	-1.3641736250	0.7633709191	-0.6388882108
##	[511]	-0.7366267121	-0.5194135592	1.0998385213	-1.0736242583	-0.2357657148
##	[516]	1.3330185831	-0.6726289844	-1.4810044363	0.6624620222	1.5031258499
##	[521]	-2.5197710954	-2.1982254934	1.9640931916	0.0849144351	-2.6211881071
##	[526]	-0.5479532070	-2.0307845863	1.1788354012	0.5496013897	0.7617577447
##	[531]	-0.4439581834	-0.5352044241	-0.8180578069	-0.1085107332	-0.6980294746
##	[536]	-0.2217853117	0.9896527178	-0.1463568290	0.3668031315	-0.3383731198
##	[541]	0.5398455813	-0.1322815208	-0.8763996301	-0.9326570229	2.0418414782
##	[546]	-1.3021224648	2.0146883693	-0.5156753607	1.3156105541	1.5856243419
##	[551]	0.0666433859	0.0429938040	-0.7465461993	-0.0043437162	-0.5234188084
##	[556]	1.5975979427	0.4748962234	-0.0046024110	0.1701050754	-0.9429074748
##	[561]	0.4106527653	1.2895382420	0.8921373337	-0.4850954052	0.1860360324
##	[566]	-0.0919060846	-2.3573909879	0.5736498845	-1.0396463361	0.0380032041
##	[571]	1.9995044827	0.1591337925	-1.2112397467	0.4138568766	0.5245696935
##	[576]	-0.2520410354	-0.8164229151	-0.4345604701	-1.6108290122	-0.3709418679

##	[581]	2.1641559300	0.0856483997	-0.8250370038	0.0252088189	-0.2607257660
##	[586]	0.1406626926	-0.9575910068	-1.2627494398	0.0364035152	-1.8845190376
##	[591]	0.6334560296	0.6097714688	1.7344801165	-0.7517723618	0.1152045125
##	[596]	1.7026918874	-0.3111196045	-1.6792186061	-0.8094193128	-0.6938909168
##	[601]	-0.4475072729	-0.7934180877	2.5412658200	-0.1631410414	-0.2346030957
##	[606]	-1.0635402581	0.5683199625	0.2656568698	0.3104459226	-0.4010656967
##	[611]	-0.3079108383	-0.9591602508	-0.2982893182	-1.2793414595	0.6640926602
##	[616]	-0.1991668924	0.6742424459	0.5147547505	-1.6455087645	0.9015827996
##	[621]	0.8654031525	1.0326624231	-1.5829532853	0.9173734321	-0.0943592272
##	[626]	0.0828113693	1.5109294385	1.5211903578	0.8293112953	0.0969202006
##	[631]	-0.1862924236	-0.0727085574	0.4598118339	-0.0081057384	-0.7837517936
##	[636]	0.1489571545	1.1613685143	-0.0036341420	1.8360022163	-0.6926241748
##	[641]	-1.2038334610	1.1433107384	-0.5525042086	-0.6846024238	2.0010827334
##	[646]	-0.7011319326	-1.6591937089	0.2384881102	-0.1014534508	0.7648239762
##	[651]	-1.8232266348	-0.5970945544	0.1245625219	1.1660923146	-0.3165919085
##	[656]	-0.3436019864	-0.5904889933	1.9822674152	-0.5317631659	-0.4639882710
##	[661]	-0.0310976821	0.4939910131	-2.7015520454	-0.2694054187	-2.5438286780
##	[666]	-1.2763020887	0.7349554211	0.6076083044	0.9078810388	0.2380619798
##	[671]	0.3980157640	1.4305389820	0.1821386684	0.1364861358	-1.2932307855
##	[676]	0.3683702553	-0.9571345226	-1.1812650087	-0.8000884449	-0.5922917141
##	[681]	-1.5451398614	0.4310073405	-1.4473497104	1.8715195702	0.4052444494
##	[686]	-0.8014118361	-1.4285600522	-0.0471703338	-1.0208759926	-0.3149591340
##	[691]	1.9457969748	-1.7757836623	-1.4410114457	1.0844702214	-0.3686797130
##	[696]	2.7591953765	-1.1748094908	0.2148508217	-0.0576388890	-0.5250243561
##	[701]	1.0705833288	1.4993830816	0.9026242721	0.6068654318	-0.7123911849
##	[706]	-1.1631480671	0.7036928109	0.3436976579	-0.3541353517	-0.4923452605
##	[711]	0.7209384161	0.7389119701	-1.1303366342	0.1931095765	-2.5100820870
##	[716]	0.4014619703	-0.2037311047	-0.3720476358	1.1265136077	-2.3222602888
##	[721]	-1.3086052191	-0.1336024694	-1.1844747899	-0.3372638539	0.5103278491
##	[726]	-0.6955413367	-0.9960582389	-0.3407881538	1.0663357528	-1.0157615817
##	[731]	2.1195678923	-0.7520162031	-0.5427061421	0.4918963417	-0.4706486555
##	[736]	-0.1270203974	-0.9524458928	0.0831122315	-0.5255949031	-0.3650336357
##	[741]	-0.4198640776	-0.4499322276	-1.0272725154	0.4045736808	1.3125049287
##	[746]	-0.0659470224	0.7308585514	-1.5086288295	-0.4897297983	0.0220558133
##	[751]	-0.1582470537	-0.2128961367	-0.7810971936	-0.5002906744	-1.6668557199
##	[756]	0.4937365091	-0.9045144503	-1.4498419089	0.1731889096	-0.3304012533
##	[761]	-0.2984263897	-1.0361599285	-1.1747040438	-1.6216498621	0.9808651844
##	[766]	-0.2709865173	-0.3219371007	-2.1825472914	1.4745686445	-0.2253025358
##	[771]	0.2411413485	0.5943490602	0.3323144044	0.9747860481	-0.3400684574
##	[776]	-1.2335886142	-0.1730538121	-1.3706442293	-1.0468817236	0.0700384416
##	[781]	0.7410743893	-0.3227284892	0.0568100528	-0.1444929125	0.2879719780
##	[786]	1.2540816645	0.3539699931	0.4633385167	-0.5614597832	1.1927271296
##	[791]	1.1436521333	1.1911588910	1.4793207852	-1.1226104222	0.1583083106
##	[796]	1.0113780775	-0.7503002248	1.3027587476	0.4489214828	1.2930403325
##	[801]	-0.6554613495	-0.1263636683	-2.2610162851	-0.8784944614	-0.3583201573

```
## [806] 1.9253656856 0.9003716749 -0.3969410234 -0.3264524974 0.1477512295
## [811] -0.2295886081 -0.6128081819 0.3155355189 -0.1099181339 1.3220972556
## [816] -0.4861313417 -0.7877629516 -0.1203086959 0.8609105906 1.2358050855
## [821] -0.1989427588 -0.7580708146 0.0623571824 0.0387815537 -0.8715400291
## [826] -1.4991823187 0.1801932279 0.3799552854 -0.8457215081 0.1384703902
## [831] -0.2455113015 -0.1882738796 -1.0297197603 0.3372484417 -0.1826462741
## [836] 1.3379205774 0.2135636714 -1.0649012403 1.0109236200 -1.1695710500
## [841] -0.4219122459 -0.9237609777 0.2731708845 0.4946704146 1.4332613662
## [846] 0.3708606691 -0.5069077091 1.7230305873 1.5740081638 0.3010928229
## [851] 1.4058156842 -0.5886827270 1.6862248384 0.2228880083 -0.2960419740
## [856] -1.3186003711 -1.5560128665 0.8852146535 0.2118716755 0.1329405815
## [861] -0.7592226625 -0.1161600585 -2.0035854235 1.3029762903 0.5469175690
## [866] -0.0036160599 0.5900015716 0.7363438776 -0.7674337537 0.7599060436
## [871] 0.7138116978 0.1616731770 0.4609217981 0.0232885397 1.9321739319
## [876] 2.8482017260 -1.5992073053 -1.2764046308 1.5606688381 2.0303602079
## [881] 1.5392757982 0.1810485034 1.4374477055 0.9865721760 0.3591474265
## [886] 0.9565600895 -0.8620738307 -1.4225771513 0.1626870790 -0.2064140833
## [891] 0.0317534506 -0.2895955758 0.5530156285 -0.7642598201 -1.1027146639
## [896] -0.6039348678 -0.0095920080 -0.1141679361 0.0881329602 0.6085203927
## [901] -1.0358681265 -0.1813927448 -0.4716787410 -0.1011534060 0.1811884918
## [906] -1.1452767381 -0.8845117602 -0.9346247049 -1.5466255486 0.6152304282
## [911] 0.8528710735 0.8541484509 -0.3783597459 -2.7288567126 -0.6637213599
## [916] 1.0449490394 0.6123914407 0.7242845278 -1.0183904749 -0.1987728459
## [921] -0.8043462340 -0.5863620618 0.8846762683 0.5827720447 -0.1713976540
## [926] 0.2806147203 -0.6130981905 1.9081028672 0.5166684750 0.0427797695
## [931] -0.1367483361 -0.2754343203 -2.8131903032 0.9516164119 -0.5762030123
## [936] 2.2186775639 -0.3815022703 1.0902626405 -1.7398050560 -1.4585228039
## [941] 1.0118446873 0.3382192100 0.4072411170 0.5156282059 -0.3349496471
## [946] 2.7100582498 0.4382310628 1.0998689802 1.2125289177 0.4084049331
## [951] -0.0981749754 0.5240456724 0.2108058384 0.0831305607 -0.0113840220
## [956] 0.3423017737 -0.3303580487 -0.0525960826 -0.0102084730 -0.7166206128
## [961] 0.3246889739 2.0560983301 0.8663676780 0.9497875087 -0.0381028960
## [966] -1.8077914784 0.8402131629 0.6917781244 0.0435659676 -1.1441624592
## [971] 0.0896602821 -1.3256308145 1.0829753027 -0.4502154958 1.0371798959
## [976] 0.0780043289 1.4579603644 -1.2704853259 -0.3536520021 -0.8387658959
## [981] -0.7500130545 0.7580350032 0.2380893064 -1.2900475651 0.6341161196
## [986] -0.1785035297 -0.1788738232 -0.9775269754 0.5623174444 0.5464078301
## [991] 0.4575856430 0.5815084954 0.0248189657 0.7256929909 2.0220345843
## [996] -0.9999116415 2.1412482202 0.3425918259 -0.5123096525 -1.6455559538
```

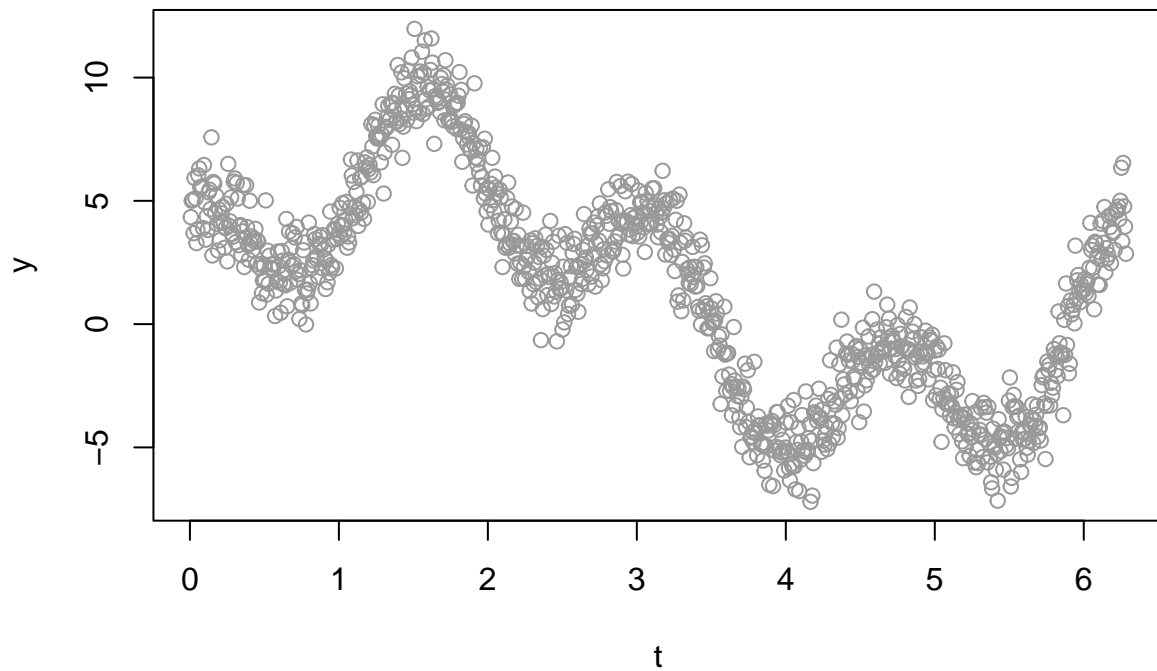
## 1-(2)번

```
k=1:1000
x1<-sin(2*pi*k/1000)
```

```
i=1:1000
x2<-cos(8*pi*i/1000)
```

### 1-(3)번

```
r=1:1000
y<- 5*sin(2*pi*r/1000)+3*cos(8*pi*r/1000)+1.5 + epsilon_i
d=1:1000
t<-2*pi*d/1000
plot(t,y,col='gray60')
```



### ##1-(4)번

```
X<-cbind(1,x1,x2)
X
```

##			x1	x2
##	[1,]	1	6.283144e-03	0.99968419
##	[2,]	1	1.256604e-02	0.99873696
##	[3,]	1	1.884844e-02	0.99715890
##	[4,]	1	2.513010e-02	0.99495102
##	[5,]	1	3.141076e-02	0.99211470

##	[6,]	1	3.769018e-02	0.98865174
##	[7,]	1	4.396812e-02	0.98456433
##	[8,]	1	5.024432e-02	0.97985505
##	[9,]	1	5.651853e-02	0.97452687
##	[10,]	1	6.279052e-02	0.96858316
##	[11,]	1	6.906003e-02	0.96202767
##	[12,]	1	7.532681e-02	0.95486454
##	[13,]	1	8.159061e-02	0.94709830
##	[14,]	1	8.785120e-02	0.93873386
##	[15,]	1	9.410831e-02	0.92977649
##	[16,]	1	1.003617e-01	0.92023185
##	[17,]	1	1.066112e-01	0.91010597
##	[18,]	1	1.128564e-01	0.89940525
##	[19,]	1	1.190972e-01	0.88813645
##	[20,]	1	1.253332e-01	0.87630668
##	[21,]	1	1.315644e-01	0.86392342
##	[22,]	1	1.377903e-01	0.85099448
##	[23,]	1	1.440108e-01	0.83752804
##	[24,]	1	1.502256e-01	0.82353260
##	[25,]	1	1.564345e-01	0.80901699
##	[26,]	1	1.626372e-01	0.79399040
##	[27,]	1	1.688334e-01	0.77846230
##	[28,]	1	1.750231e-01	0.76244251
##	[29,]	1	1.812058e-01	0.74594115
##	[30,]	1	1.873813e-01	0.72896863
##	[31,]	1	1.935495e-01	0.71153568
##	[32,]	1	1.997100e-01	0.69365331
##	[33,]	1	2.058626e-01	0.67533281
##	[34,]	1	2.120071e-01	0.65658576
##	[35,]	1	2.181432e-01	0.63742399
##	[36,]	1	2.242708e-01	0.61785961
##	[37,]	1	2.303894e-01	0.59790498
##	[38,]	1	2.364990e-01	0.57757270
##	[39,]	1	2.425992e-01	0.55687562
##	[40,]	1	2.486899e-01	0.53582679
##	[41,]	1	2.547707e-01	0.51443953
##	[42,]	1	2.608415e-01	0.49272734
##	[43,]	1	2.669020e-01	0.47070393
##	[44,]	1	2.729519e-01	0.44838322
##	[45,]	1	2.789911e-01	0.42577929
##	[46,]	1	2.850193e-01	0.40290644
##	[47,]	1	2.910362e-01	0.37977910
##	[48,]	1	2.970416e-01	0.35641188
##	[49,]	1	3.030353e-01	0.33281954
##	[50,]	1	3.090170e-01	0.30901699

```

## [51,] 1 3.149865e-01 0.28501926
## [52,] 1 3.209436e-01 0.26084151
## [53,] 1 3.268880e-01 0.23649900
## [54,] 1 3.328195e-01 0.21200711
## [55,] 1 3.387379e-01 0.18738131
## [56,] 1 3.446429e-01 0.16263717
## [57,] 1 3.505343e-01 0.13779029
## [58,] 1 3.564119e-01 0.11285638
## [59,] 1 3.622754e-01 0.08785120
## [60,] 1 3.681246e-01 0.06279052
## [61,] 1 3.739592e-01 0.03769018
## [62,] 1 3.797791e-01 0.01256604
## [63,] 1 3.855840e-01 -0.01256604
## [64,] 1 3.913737e-01 -0.03769018
## [65,] 1 3.971479e-01 -0.06279052
## [66,] 1 4.029064e-01 -0.08785120
## [67,] 1 4.086491e-01 -0.11285638
## [68,] 1 4.143756e-01 -0.13779029
## [69,] 1 4.200857e-01 -0.16263717
## [70,] 1 4.257793e-01 -0.18738131
## [71,] 1 4.314560e-01 -0.21200711
## [72,] 1 4.371158e-01 -0.23649900
## [73,] 1 4.427582e-01 -0.26084151
## [74,] 1 4.483832e-01 -0.28501926
## [75,] 1 4.539905e-01 -0.30901699
## [76,] 1 4.595799e-01 -0.33281954
## [77,] 1 4.651511e-01 -0.35641188
## [78,] 1 4.707039e-01 -0.37977910
## [79,] 1 4.762382e-01 -0.40290644
## [80,] 1 4.817537e-01 -0.42577929
## [81,] 1 4.872501e-01 -0.44838322
## [82,] 1 4.927273e-01 -0.47070393
## [83,] 1 4.981851e-01 -0.49272734
## [84,] 1 5.036232e-01 -0.51443953
## [85,] 1 5.090414e-01 -0.53582679
## [86,] 1 5.144395e-01 -0.55687562
## [87,] 1 5.198173e-01 -0.57757270
## [88,] 1 5.251746e-01 -0.59790498
## [89,] 1 5.305112e-01 -0.61785961
## [90,] 1 5.358268e-01 -0.63742399
## [91,] 1 5.411213e-01 -0.65658576
## [92,] 1 5.463943e-01 -0.67533281
## [93,] 1 5.516459e-01 -0.69365331
## [94,] 1 5.568756e-01 -0.71153568
## [95,] 1 5.620834e-01 -0.72896863

```



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## [96,] 1 5.672689e-01 -0.74594115
## [97,] 1 5.724321e-01 -0.76244251
## [98,] 1 5.775727e-01 -0.77846230
## [99,] 1 5.826905e-01 -0.79399040
## [100,] 1 5.877853e-01 -0.80901699
## [101,] 1 5.928568e-01 -0.82353260
## [102,] 1 5.979050e-01 -0.83752804
## [103,] 1 6.029295e-01 -0.85099448
## [104,] 1 6.079303e-01 -0.86392342
## [105,] 1 6.129071e-01 -0.87630668
## [106,] 1 6.178596e-01 -0.88813645
## [107,] 1 6.227878e-01 -0.89940525
## [108,] 1 6.276914e-01 -0.91010597
## [109,] 1 6.325702e-01 -0.92023185
## [110,] 1 6.374240e-01 -0.92977649
## [111,] 1 6.422527e-01 -0.93873386
## [112,] 1 6.470560e-01 -0.94709830
## [113,] 1 6.518337e-01 -0.95486454
## [114,] 1 6.565858e-01 -0.96202767
## [115,] 1 6.613119e-01 -0.96858316
## [116,] 1 6.660119e-01 -0.97452687
## [117,] 1 6.706856e-01 -0.97985505
## [118,] 1 6.753328e-01 -0.98456433
## [119,] 1 6.799534e-01 -0.98865174
## [120,] 1 6.845471e-01 -0.99211470
## [121,] 1 6.891138e-01 -0.99495102
## [122,] 1 6.936533e-01 -0.99715890
## [123,] 1 6.981654e-01 -0.99873696
## [124,] 1 7.026500e-01 -0.99968419
## [125,] 1 7.071068e-01 -1.00000000
## [126,] 1 7.115357e-01 -0.99968419
## [127,] 1 7.159365e-01 -0.99873696
## [128,] 1 7.203090e-01 -0.99715890
## [129,] 1 7.246531e-01 -0.99495102
## [130,] 1 7.289686e-01 -0.99211470
## [131,] 1 7.332553e-01 -0.98865174
## [132,] 1 7.375131e-01 -0.98456433
## [133,] 1 7.417418e-01 -0.97985505
## [134,] 1 7.459411e-01 -0.97452687
## [135,] 1 7.501111e-01 -0.96858316
## [136,] 1 7.542514e-01 -0.96202767
## [137,] 1 7.583619e-01 -0.95486454
## [138,] 1 7.624425e-01 -0.94709830
## [139,] 1 7.664930e-01 -0.93873386
## [140,] 1 7.705132e-01 -0.92977649

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```

## [141,] 1 7.745031e-01 -0.92023185
## [142,] 1 7.784623e-01 -0.91010597
## [143,] 1 7.823908e-01 -0.89940525
## [144,] 1 7.862884e-01 -0.88813645
## [145,] 1 7.901550e-01 -0.87630668
## [146,] 1 7.939904e-01 -0.86392342
## [147,] 1 7.977944e-01 -0.85099448
## [148,] 1 8.015670e-01 -0.83752804
## [149,] 1 8.053079e-01 -0.82353260
## [150,] 1 8.090170e-01 -0.80901699
## [151,] 1 8.126942e-01 -0.79399040
## [152,] 1 8.163393e-01 -0.77846230
## [153,] 1 8.199521e-01 -0.76244251
## [154,] 1 8.235326e-01 -0.74594115
## [155,] 1 8.270806e-01 -0.72896863
## [156,] 1 8.305959e-01 -0.71153568
## [157,] 1 8.340784e-01 -0.69365331
## [158,] 1 8.375280e-01 -0.67533281
## [159,] 1 8.409446e-01 -0.65658576
## [160,] 1 8.443279e-01 -0.63742399
## [161,] 1 8.476779e-01 -0.61785961
## [162,] 1 8.509945e-01 -0.59790498
## [163,] 1 8.542774e-01 -0.57757270
## [164,] 1 8.575267e-01 -0.55687562
## [165,] 1 8.607420e-01 -0.53582679
## [166,] 1 8.639234e-01 -0.51443953
## [167,] 1 8.670707e-01 -0.49272734
## [168,] 1 8.701838e-01 -0.47070393
## [169,] 1 8.732625e-01 -0.44838322
## [170,] 1 8.763067e-01 -0.42577929
## [171,] 1 8.793163e-01 -0.40290644
## [172,] 1 8.822912e-01 -0.37977910
## [173,] 1 8.852313e-01 -0.35641188
## [174,] 1 8.881364e-01 -0.33281954
## [175,] 1 8.910065e-01 -0.30901699
## [176,] 1 8.938414e-01 -0.28501926
## [177,] 1 8.966410e-01 -0.26084151
## [178,] 1 8.994053e-01 -0.23649900
## [179,] 1 9.021340e-01 -0.21200711
## [180,] 1 9.048271e-01 -0.18738131
## [181,] 1 9.074844e-01 -0.16263717
## [182,] 1 9.101060e-01 -0.13779029
## [183,] 1 9.126916e-01 -0.11285638
## [184,] 1 9.152412e-01 -0.08785120
## [185,] 1 9.177546e-01 -0.06279052

```

```

## [186,] 1 9.202318e-01 -0.03769018
## [187,] 1 9.226727e-01 -0.01256604
## [188,] 1 9.250772e-01 0.01256604
## [189,] 1 9.274452e-01 0.03769018
## [190,] 1 9.297765e-01 0.06279052
## [191,] 1 9.320711e-01 0.08785120
## [192,] 1 9.343289e-01 0.11285638
## [193,] 1 9.365499e-01 0.13779029
## [194,] 1 9.387339e-01 0.16263717
## [195,] 1 9.408808e-01 0.18738131
## [196,] 1 9.429905e-01 0.21200711
## [197,] 1 9.450631e-01 0.23649900
## [198,] 1 9.470983e-01 0.26084151
## [199,] 1 9.490961e-01 0.28501926
## [200,] 1 9.510565e-01 0.30901699
## [201,] 1 9.529793e-01 0.33281954
## [202,] 1 9.548645e-01 0.35641188
## [203,] 1 9.567121e-01 0.37977910
## [204,] 1 9.585218e-01 0.40290644
## [205,] 1 9.602937e-01 0.42577929
## [206,] 1 9.620277e-01 0.44838322
## [207,] 1 9.637237e-01 0.47070393
## [208,] 1 9.653816e-01 0.49272734
## [209,] 1 9.670015e-01 0.51443953
## [210,] 1 9.685832e-01 0.53582679
## [211,] 1 9.701266e-01 0.55687562
## [212,] 1 9.716317e-01 0.57757270
## [213,] 1 9.730985e-01 0.59790498
## [214,] 1 9.745269e-01 0.61785961
## [215,] 1 9.759168e-01 0.63742399
## [216,] 1 9.772681e-01 0.65658576
## [217,] 1 9.785809e-01 0.67533281
## [218,] 1 9.798551e-01 0.69365331
## [219,] 1 9.810905e-01 0.71153568
## [220,] 1 9.822873e-01 0.72896863
## [221,] 1 9.834452e-01 0.74594115
## [222,] 1 9.845643e-01 0.76244251
## [223,] 1 9.856446e-01 0.77846230
## [224,] 1 9.866859e-01 0.79399040
## [225,] 1 9.876883e-01 0.80901699
## [226,] 1 9.886517e-01 0.82353260
## [227,] 1 9.895761e-01 0.83752804
## [228,] 1 9.904614e-01 0.85099448
## [229,] 1 9.913076e-01 0.86392342
## [230,] 1 9.921147e-01 0.87630668

```

##	[231,]	1	9.928826e-01	0.88813645
##	[232,]	1	9.936113e-01	0.89940525
##	[233,]	1	9.943008e-01	0.91010597
##	[234,]	1	9.949510e-01	0.92023185
##	[235,]	1	9.955620e-01	0.92977649
##	[236,]	1	9.961336e-01	0.93873386
##	[237,]	1	9.966659e-01	0.94709830
##	[238,]	1	9.971589e-01	0.95486454
##	[239,]	1	9.976125e-01	0.96202767
##	[240,]	1	9.980267e-01	0.96858316
##	[241,]	1	9.984016e-01	0.97452687
##	[242,]	1	9.987370e-01	0.97985505
##	[243,]	1	9.990329e-01	0.98456433
##	[244,]	1	9.992895e-01	0.98865174
##	[245,]	1	9.995066e-01	0.99211470
##	[246,]	1	9.996842e-01	0.99495102
##	[247,]	1	9.998224e-01	0.99715890
##	[248,]	1	9.999210e-01	0.99873696
##	[249,]	1	9.999803e-01	0.99968419
##	[250,]	1	1.000000e+00	1.00000000
##	[251,]	1	9.999803e-01	0.99968419
##	[252,]	1	9.999210e-01	0.99873696
##	[253,]	1	9.998224e-01	0.99715890
##	[254,]	1	9.996842e-01	0.99495102
##	[255,]	1	9.995066e-01	0.99211470
##	[256,]	1	9.992895e-01	0.98865174
##	[257,]	1	9.990329e-01	0.98456433
##	[258,]	1	9.987370e-01	0.97985505
##	[259,]	1	9.984016e-01	0.97452687
##	[260,]	1	9.980267e-01	0.96858316
##	[261,]	1	9.976125e-01	0.96202767
##	[262,]	1	9.971589e-01	0.95486454
##	[263,]	1	9.966659e-01	0.94709830
##	[264,]	1	9.961336e-01	0.93873386
##	[265,]	1	9.955620e-01	0.92977649
##	[266,]	1	9.949510e-01	0.92023185
##	[267,]	1	9.943008e-01	0.91010597
##	[268,]	1	9.936113e-01	0.89940525
##	[269,]	1	9.928826e-01	0.88813645
##	[270,]	1	9.921147e-01	0.87630668
##	[271,]	1	9.913076e-01	0.86392342
##	[272,]	1	9.904614e-01	0.85099448
##	[273,]	1	9.895761e-01	0.83752804
##	[274,]	1	9.886517e-01	0.82353260
##	[275,]	1	9.876883e-01	0.80901699

##	[276,]	1	9.866859e-01	0.79399040
##	[277,]	1	9.856446e-01	0.77846230
##	[278,]	1	9.845643e-01	0.76244251
##	[279,]	1	9.834452e-01	0.74594115
##	[280,]	1	9.822873e-01	0.72896863
##	[281,]	1	9.810905e-01	0.71153568
##	[282,]	1	9.798551e-01	0.69365331
##	[283,]	1	9.785809e-01	0.67533281
##	[284,]	1	9.772681e-01	0.65658576
##	[285,]	1	9.759168e-01	0.63742399
##	[286,]	1	9.745269e-01	0.61785961
##	[287,]	1	9.730985e-01	0.59790498
##	[288,]	1	9.716317e-01	0.57757270
##	[289,]	1	9.701266e-01	0.55687562
##	[290,]	1	9.685832e-01	0.53582679
##	[291,]	1	9.670015e-01	0.51443953
##	[292,]	1	9.653816e-01	0.49272734
##	[293,]	1	9.637237e-01	0.47070393
##	[294,]	1	9.620277e-01	0.44838322
##	[295,]	1	9.602937e-01	0.42577929
##	[296,]	1	9.585218e-01	0.40290644
##	[297,]	1	9.567121e-01	0.37977910
##	[298,]	1	9.548645e-01	0.35641188
##	[299,]	1	9.529793e-01	0.33281954
##	[300,]	1	9.510565e-01	0.30901699
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## [654,] 1 -8.235326e-01 -0.74594115
## [655,] 1 -8.270806e-01 -0.72896863
## [656,] 1 -8.305959e-01 -0.71153568
## [657,] 1 -8.340784e-01 -0.69365331
## [658,] 1 -8.375280e-01 -0.67533281
## [659,] 1 -8.409446e-01 -0.65658576
## [660,] 1 -8.443279e-01 -0.63742399
## [661,] 1 -8.476779e-01 -0.61785961
## [662,] 1 -8.509945e-01 -0.59790498
## [663,] 1 -8.542774e-01 -0.57757270
## [664,] 1 -8.575267e-01 -0.55687562
## [665,] 1 -8.607420e-01 -0.53582679
## [666,] 1 -8.639234e-01 -0.51443953
## [667,] 1 -8.670707e-01 -0.49272734
## [668,] 1 -8.701838e-01 -0.47070393
## [669,] 1 -8.732625e-01 -0.44838322
## [670,] 1 -8.763067e-01 -0.42577929
## [671,] 1 -8.793163e-01 -0.40290644
## [672,] 1 -8.822912e-01 -0.37977910
## [673,] 1 -8.852313e-01 -0.35641188
## [674,] 1 -8.881364e-01 -0.33281954
## [675,] 1 -8.910065e-01 -0.30901699
## [676,] 1 -8.938414e-01 -0.28501926
## [677,] 1 -8.966410e-01 -0.26084151
## [678,] 1 -8.994053e-01 -0.23649900
## [679,] 1 -9.021340e-01 -0.21200711
## [680,] 1 -9.048271e-01 -0.18738131

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## [681,] 1 -9.074844e-01 -0.16263717
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## [683,] 1 -9.126916e-01 -0.11285638
## [684,] 1 -9.152412e-01 -0.08785120
## [685,] 1 -9.177546e-01 -0.06279052
## [686,] 1 -9.202318e-01 -0.03769018
## [687,] 1 -9.226727e-01 -0.01256604
## [688,] 1 -9.250772e-01 0.01256604
## [689,] 1 -9.274452e-01 0.03769018
## [690,] 1 -9.297765e-01 0.06279052
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## [693,] 1 -9.365499e-01 0.13779029
## [694,] 1 -9.387339e-01 0.16263717
## [695,] 1 -9.408808e-01 0.18738131
## [696,] 1 -9.429905e-01 0.21200711
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## [701,] 1 -9.529793e-01 0.33281954
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## [704,] 1 -9.585218e-01 0.40290644
## [705,] 1 -9.602937e-01 0.42577929
## [706,] 1 -9.620277e-01 0.44838322
## [707,] 1 -9.637237e-01 0.47070393
## [708,] 1 -9.653816e-01 0.49272734
## [709,] 1 -9.670015e-01 0.51443953
## [710,] 1 -9.685832e-01 0.53582679
## [711,] 1 -9.701266e-01 0.55687562
## [712,] 1 -9.716317e-01 0.57757270
## [713,] 1 -9.730985e-01 0.59790498
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## [718,] 1 -9.798551e-01 0.69365331
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## [721,] 1 -9.834452e-01 0.74594115
## [722,] 1 -9.845643e-01 0.76244251
## [723,] 1 -9.856446e-01 0.77846230
## [724,] 1 -9.866859e-01 0.79399040
## [725,] 1 -9.876883e-01 0.80901699

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## [726,] 1 -9.886517e-01 0.82353260
## [727,] 1 -9.895761e-01 0.83752804
## [728,] 1 -9.904614e-01 0.85099448
## [729,] 1 -9.913076e-01 0.86392342
## [730,] 1 -9.921147e-01 0.87630668
## [731,] 1 -9.928826e-01 0.88813645
## [732,] 1 -9.936113e-01 0.89940525
## [733,] 1 -9.943008e-01 0.91010597
## [734,] 1 -9.949510e-01 0.92023185
## [735,] 1 -9.955620e-01 0.92977649
## [736,] 1 -9.961336e-01 0.93873386
## [737,] 1 -9.966659e-01 0.94709830
## [738,] 1 -9.971589e-01 0.95486454
## [739,] 1 -9.976125e-01 0.96202767
## [740,] 1 -9.980267e-01 0.96858316
## [741,] 1 -9.984016e-01 0.97452687
## [742,] 1 -9.987370e-01 0.97985505
## [743,] 1 -9.990329e-01 0.98456433
## [744,] 1 -9.992895e-01 0.98865174
## [745,] 1 -9.995066e-01 0.99211470
## [746,] 1 -9.996842e-01 0.99495102
## [747,] 1 -9.998224e-01 0.99715890
## [748,] 1 -9.999210e-01 0.99873696
## [749,] 1 -9.999803e-01 0.99968419
## [750,] 1 -1.000000e+00 1.00000000
## [751,] 1 -9.999803e-01 0.99968419
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## [768,] 1 -9.936113e-01 0.89940525
## [769,] 1 -9.928826e-01 0.88813645
## [770,] 1 -9.921147e-01 0.87630668

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## [771,] 1 -9.913076e-01 0.86392342
## [772,] 1 -9.904614e-01 0.85099448
## [773,] 1 -9.895761e-01 0.83752804
## [774,] 1 -9.886517e-01 0.82353260
## [775,] 1 -9.876883e-01 0.80901699
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## [779,] 1 -9.834452e-01 0.74594115
## [780,] 1 -9.822873e-01 0.72896863
## [781,] 1 -9.810905e-01 0.71153568
## [782,] 1 -9.798551e-01 0.69365331
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## [784,] 1 -9.772681e-01 0.65658576
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## [795,] 1 -9.602937e-01 0.42577929
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## [797,] 1 -9.567121e-01 0.37977910
## [798,] 1 -9.548645e-01 0.35641188
## [799,] 1 -9.529793e-01 0.33281954
## [800,] 1 -9.510565e-01 0.30901699
## [801,] 1 -9.490961e-01 0.28501926
## [802,] 1 -9.470983e-01 0.26084151
## [803,] 1 -9.450631e-01 0.23649900
## [804,] 1 -9.429905e-01 0.21200711
## [805,] 1 -9.408808e-01 0.18738131
## [806,] 1 -9.387339e-01 0.16263717
## [807,] 1 -9.365499e-01 0.13779029
## [808,] 1 -9.343289e-01 0.11285638
## [809,] 1 -9.320711e-01 0.08785120
## [810,] 1 -9.297765e-01 0.06279052
## [811,] 1 -9.274452e-01 0.03769018
## [812,] 1 -9.250772e-01 0.01256604
## [813,] 1 -9.226727e-01 -0.01256604
## [814,] 1 -9.202318e-01 -0.03769018
## [815,] 1 -9.177546e-01 -0.06279052

```



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## [816,] 1 -9.152412e-01 -0.08785120
## [817,] 1 -9.126916e-01 -0.11285638
## [818,] 1 -9.101060e-01 -0.13779029
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## [820,] 1 -9.048271e-01 -0.18738131
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## [827,] 1 -8.852313e-01 -0.35641188
## [828,] 1 -8.822912e-01 -0.37977910
## [829,] 1 -8.793163e-01 -0.40290644
## [830,] 1 -8.763067e-01 -0.42577929
## [831,] 1 -8.732625e-01 -0.44838322
## [832,] 1 -8.701838e-01 -0.47070393
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## [834,] 1 -8.639234e-01 -0.51443953
## [835,] 1 -8.607420e-01 -0.53582679
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## [842,] 1 -8.375280e-01 -0.67533281
## [843,] 1 -8.340784e-01 -0.69365331
## [844,] 1 -8.305959e-01 -0.71153568
## [845,] 1 -8.270806e-01 -0.72896863
## [846,] 1 -8.235326e-01 -0.74594115
## [847,] 1 -8.199521e-01 -0.76244251
## [848,] 1 -8.163393e-01 -0.77846230
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## [851,] 1 -8.053079e-01 -0.82353260
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## [854,] 1 -7.939904e-01 -0.86392342
## [855,] 1 -7.901550e-01 -0.87630668
## [856,] 1 -7.862884e-01 -0.88813645
## [857,] 1 -7.823908e-01 -0.89940525
## [858,] 1 -7.784623e-01 -0.91010597
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## [860,] 1 -7.705132e-01 -0.92977649

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## [863,] 1 -7.583619e-01 -0.95486454
## [864,] 1 -7.542514e-01 -0.96202767
## [865,] 1 -7.501111e-01 -0.96858316
## [866,] 1 -7.459411e-01 -0.97452687
## [867,] 1 -7.417418e-01 -0.97985505
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## [869,] 1 -7.332553e-01 -0.98865174
## [870,] 1 -7.289686e-01 -0.99211470
## [871,] 1 -7.246531e-01 -0.99495102
## [872,] 1 -7.203090e-01 -0.99715890
## [873,] 1 -7.159365e-01 -0.99873696
## [874,] 1 -7.115357e-01 -0.99968419
## [875,] 1 -7.071068e-01 -1.00000000
## [876,] 1 -7.026500e-01 -0.99968419
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## [881,] 1 -6.799534e-01 -0.98865174
## [882,] 1 -6.753328e-01 -0.98456433
## [883,] 1 -6.706856e-01 -0.97985505
## [884,] 1 -6.660119e-01 -0.97452687
## [885,] 1 -6.613119e-01 -0.96858316
## [886,] 1 -6.565858e-01 -0.96202767
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## [888,] 1 -6.470560e-01 -0.94709830
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## [892,] 1 -6.276914e-01 -0.91010597
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## [895,] 1 -6.129071e-01 -0.87630668
## [896,] 1 -6.079303e-01 -0.86392342
## [897,] 1 -6.029295e-01 -0.85099448
## [898,] 1 -5.979050e-01 -0.83752804
## [899,] 1 -5.928568e-01 -0.82353260
## [900,] 1 -5.877853e-01 -0.80901699
## [901,] 1 -5.826905e-01 -0.79399040
## [902,] 1 -5.775727e-01 -0.77846230
## [903,] 1 -5.724321e-01 -0.76244251
## [904,] 1 -5.672689e-01 -0.74594115
## [905,] 1 -5.620834e-01 -0.72896863

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## [909,] 1 -5.411213e-01 -0.65658576
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## [912,] 1 -5.251746e-01 -0.59790498
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## [914,] 1 -5.144395e-01 -0.55687562
## [915,] 1 -5.090414e-01 -0.53582679
## [916,] 1 -5.036232e-01 -0.51443953
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## [918,] 1 -4.927273e-01 -0.47070393
## [919,] 1 -4.872501e-01 -0.44838322
## [920,] 1 -4.817537e-01 -0.42577929
## [921,] 1 -4.762382e-01 -0.40290644
## [922,] 1 -4.707039e-01 -0.37977910
## [923,] 1 -4.651511e-01 -0.35641188
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## [925,] 1 -4.539905e-01 -0.30901699
## [926,] 1 -4.483832e-01 -0.28501926
## [927,] 1 -4.427582e-01 -0.26084151
## [928,] 1 -4.371158e-01 -0.23649900
## [929,] 1 -4.314560e-01 -0.21200711
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## [945,] 1 -3.387379e-01 0.18738131
## [946,] 1 -3.328195e-01 0.21200711
## [947,] 1 -3.268880e-01 0.23649900
## [948,] 1 -3.209436e-01 0.26084151
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## [950,] 1 -3.090170e-01 0.30901699

```

```

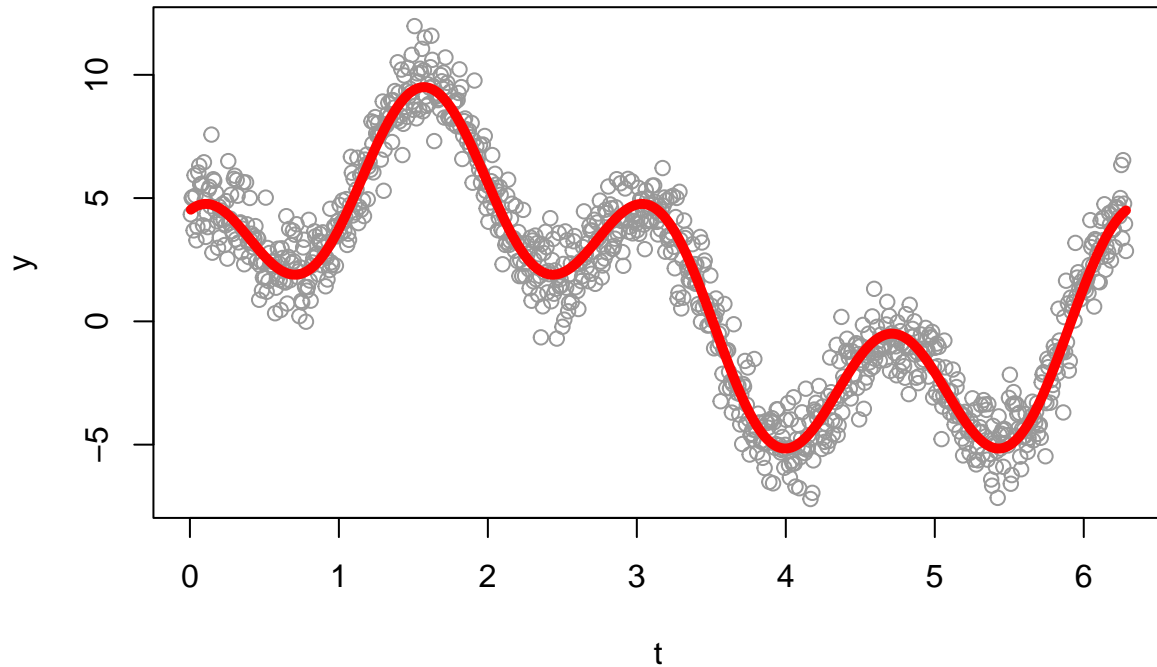
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## [952,] 1 -2.970416e-01 0.35641188
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## [955,] 1 -2.789911e-01 0.42577929
## [956,] 1 -2.729519e-01 0.44838322
## [957,] 1 -2.669020e-01 0.47070393
## [958,] 1 -2.608415e-01 0.49272734
## [959,] 1 -2.547707e-01 0.51443953
## [960,] 1 -2.486899e-01 0.53582679
## [961,] 1 -2.425992e-01 0.55687562
## [962,] 1 -2.364990e-01 0.57757270
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## [964,] 1 -2.242708e-01 0.61785961
## [965,] 1 -2.181432e-01 0.63742399
## [966,] 1 -2.120071e-01 0.65658576
## [967,] 1 -2.058626e-01 0.67533281
## [968,] 1 -1.997100e-01 0.69365331
## [969,] 1 -1.935495e-01 0.71153568
## [970,] 1 -1.873813e-01 0.72896863
## [971,] 1 -1.812058e-01 0.74594115
## [972,] 1 -1.750231e-01 0.76244251
## [973,] 1 -1.688334e-01 0.77846230
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## [976,] 1 -1.502256e-01 0.82353260
## [977,] 1 -1.440108e-01 0.83752804
## [978,] 1 -1.377903e-01 0.85099448
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## [980,] 1 -1.253332e-01 0.87630668
## [981,] 1 -1.190972e-01 0.88813645
## [982,] 1 -1.128564e-01 0.89940525
## [983,] 1 -1.066112e-01 0.91010597
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## [988,] 1 -7.532681e-02 0.95486454
## [989,] 1 -6.906003e-02 0.96202767
## [990,] 1 -6.279052e-02 0.96858316
## [991,] 1 -5.651853e-02 0.97452687
## [992,] 1 -5.024432e-02 0.97985505
## [993,] 1 -4.396812e-02 0.98456433
## [994,] 1 -3.769018e-02 0.98865174
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```

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## [996,] 1 -2.513010e-02 0.99495102
## [997,] 1 -1.884844e-02 0.99715890
## [998,] 1 -1.256604e-02 0.99873696
## [999,] 1 -6.283144e-03 0.99968419
## [1000,] 1 -2.449213e-16 1.00000000
```

##1-(5)번

```
β<-rbind(1.5,5,3)
j<- X %*% β
plot(t,y,col='gray60')
lines(t,j,col='red',lwd='5')
```



##1-(6)번

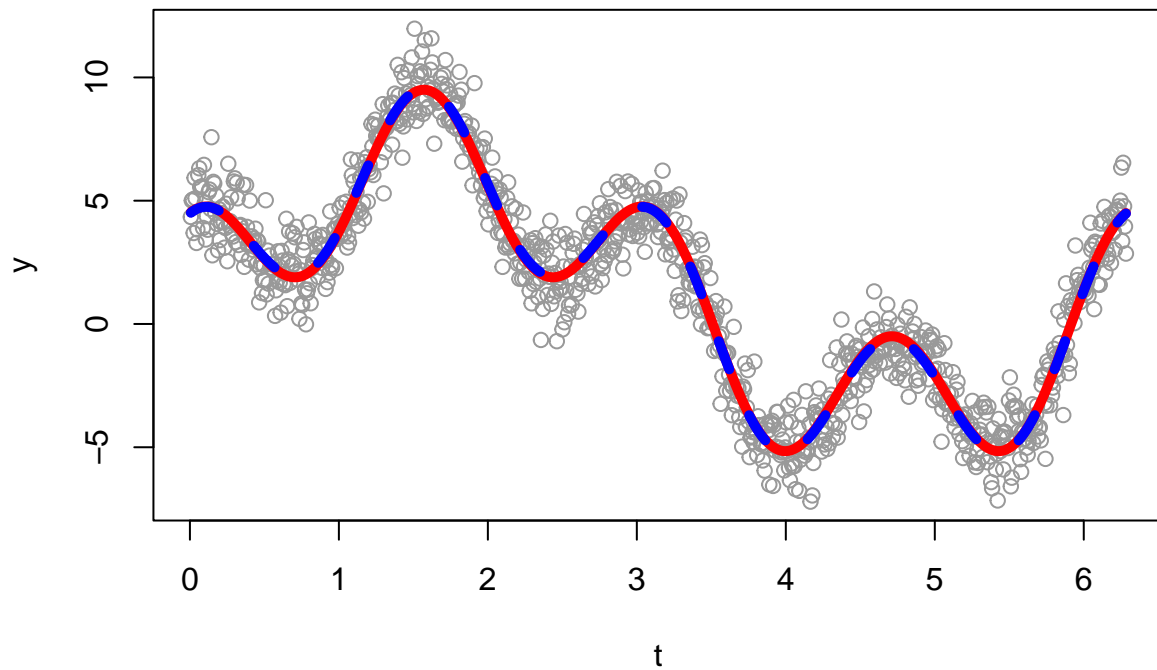
```
X<-cbind(1,x1,x2)
Y<-cbind(y)
A<- t(X)
B<- solve(A%*%X)
hatβ <- B %*% A %*% Y
```

##1-(7)번

```

Xhatβ <- X%*%hatβ
plot(t,y,col='gray60')
lines(t,j,col='red',lwd='5')
lines(t,Xhatβ,ltty="dashed",col="blue",lwd='5')

```

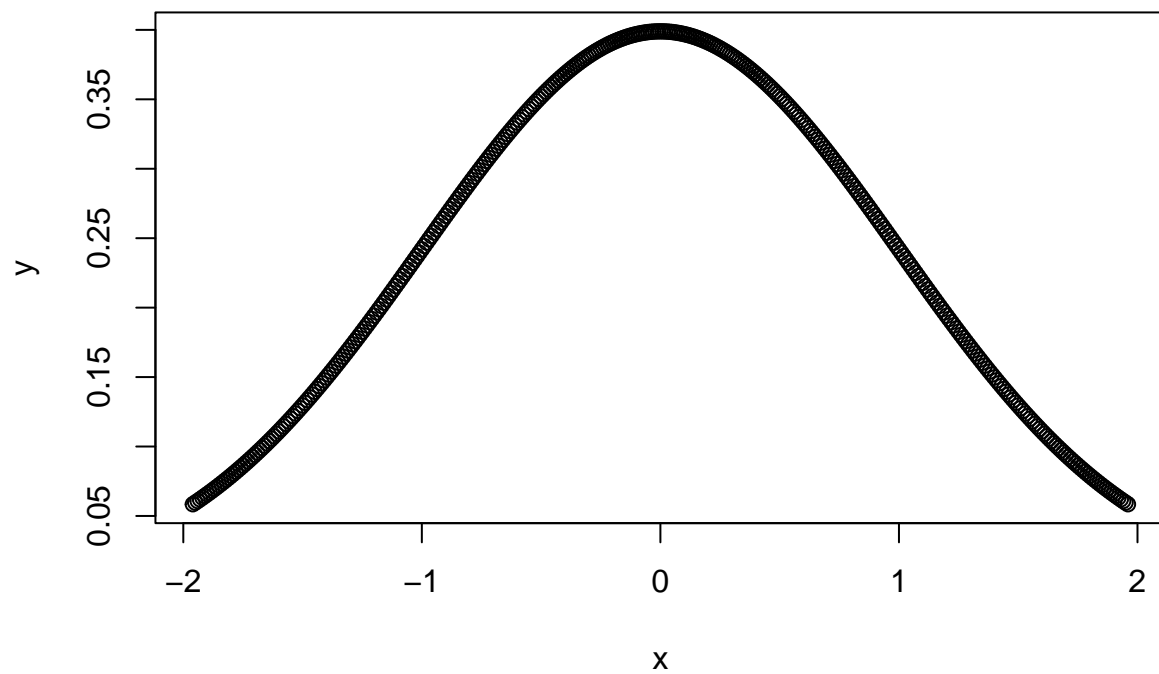


##2-(1)번

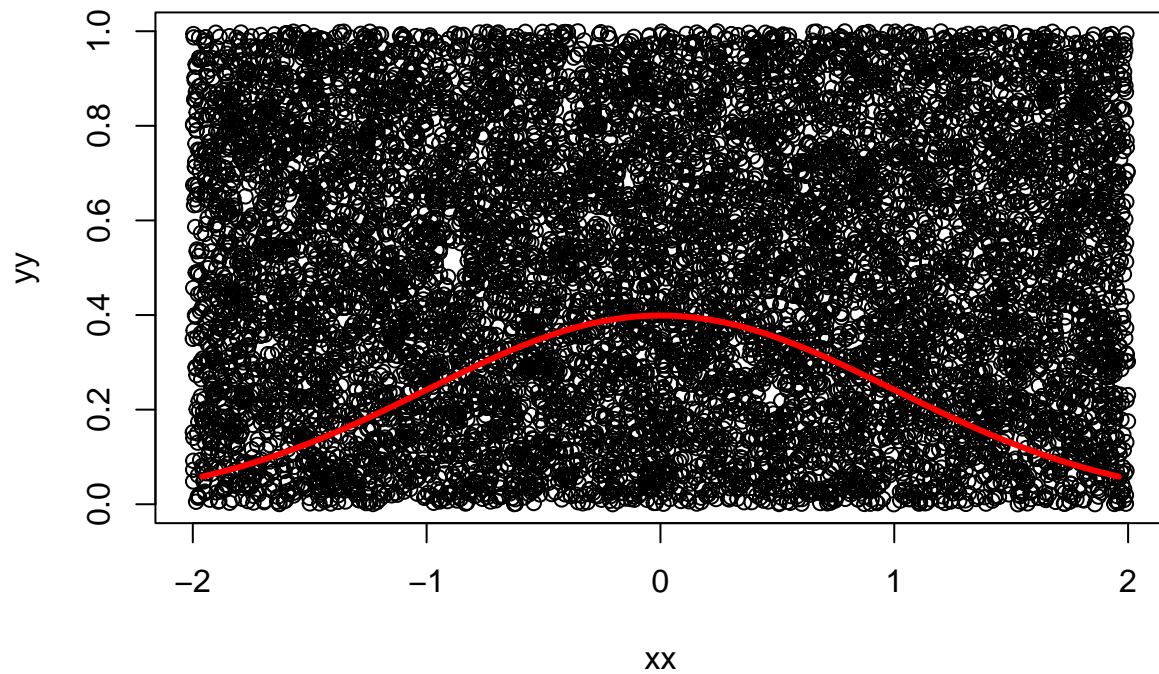
```

x=seq(from=-1.96, to=1.96 , by=0.01)
y=1/sqrt(2*pi)*exp(-x^2/2)
plot(x,y)

```

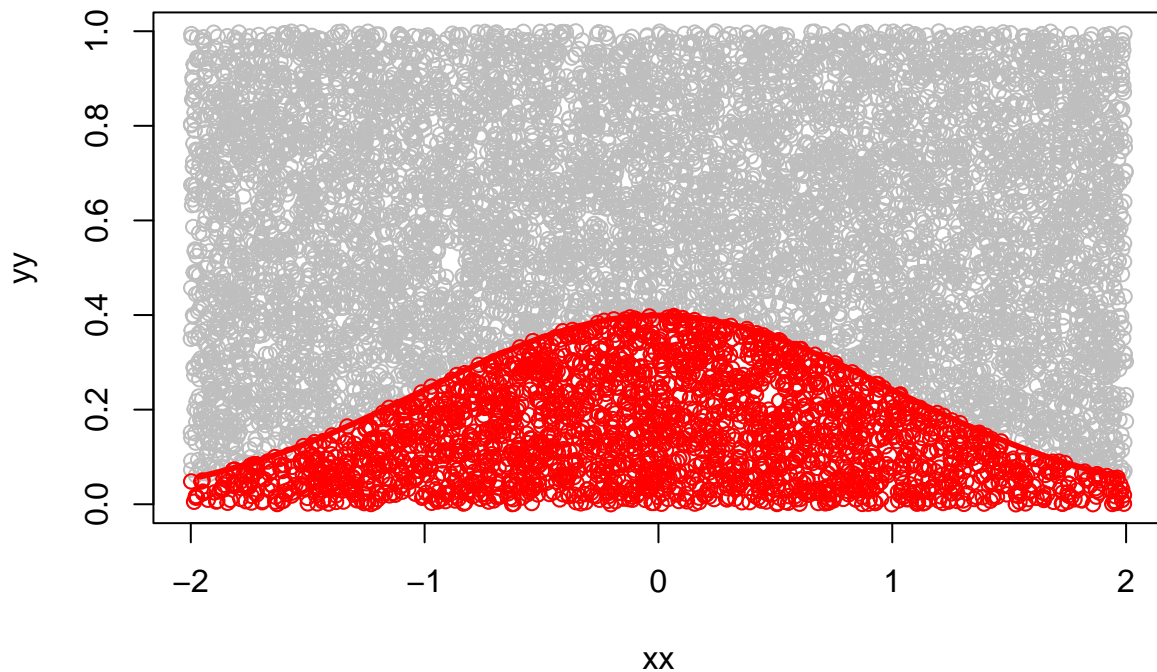


```
xx=runif(10000)*4-2  
yy=runif(10000)  
plot(xx,yy)  
lines(x,y,col='red',lwd=3)
```



```
test = function(xx,yy){  
  yy < 1/sqrt(2*pi)*exp(-xx^2/2)  
}  
tst = c()  
for (i in 1:10000) tst[i] = test(xx[i],yy[i])  
plot(xx,yy,col='gray')  
lines(x,y,col='red',lwd=3)  
points(xx[tst],yy[tst],col='red')
```





```
sum(tst)
```

```
## [1] 2440
```

```
##sum(tst)의 개수/1000*4 가 대략적인 넓이
```

```
##2-(2)번
```

```
library(tidyverse)
```

```
## Warning: 패키지 'tidyverse'는 R 버전 4.1.2에서 작성되었습니다
```

```
## -- Attaching packages ----- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5      v purrr   0.3.4
```

```
## v tibble  3.1.6      v dplyr   1.0.7
```

```
## v tidyr   1.1.4      v stringr 1.4.0
```

```
## v readr   2.1.1      v forcats 0.5.1
```

```
## Warning: 패키지 'ggplot2'는 R 버전 4.1.2에서 작성되었습니다
```

```
## Warning: 패키지 'tibble'는 R 버전 4.1.2에서 작성되었습니다
```

```
## Warning: 패키지 'tidyr'는 R 버전 4.1.2에서 작성되었습니다
```

```
## Warning: 패키지 'readr'는 R 버전 4.1.2에서 작성되었습니다
```

```
## Warning: 패키지 'purrr'는 R 버전 4.1.2에서 작성되었습니다
## Warning: 패키지 'dplyr'는 R 버전 4.1.2에서 작성되었습니다
## Warning: 패키지 'stringr'는 R 버전 4.1.2에서 작성되었습니다
## Warning: 패키지 'forcats'는 R 버전 4.1.2에서 작성되었습니다

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag() masks stats::lag()

x<-rnorm(1000)
dim(x) = c(1000,1)
X<-as_tibble(x)

## Warning: The `x` argument of `as_tibble.matrix()` must have unique column names if `.
## Using compatibility `.name_repair`.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was generated.

X %>% filter(V1>-1.96 & V1<1.96)

## # A tibble: 952 x 1
##       V1
##   <dbl>
## 1  0.159
## 2  1.07
## 3  0.373
## 4 -0.119
## 5  1.11
## 6  0.303
## 7 -0.874
## 8 -1.76
## 9  0.949
## 10 0.766
## # ... with 942 more rows
```

(-1.96~ 1.96 사이에 있는 확률변수의 개수는 filter의 개수이다.)

### 3번 (A)

```
APR=c('N1','N2','N3','N4','N5','N6','N7','N8','A','N10')
SURV=10
PLAYER=APR[SURV]
STAGE=0
PROB=0.5
TOSSRSLT=NA
```

```

library(tidyverse)
toss=function(p) rbinom(n=1,size=1,prob=p) %>% as.logical

reset=function(){
  TOSSRSLT<-NA
  SURV<- 10
  STAGE<- 0
  PLAYER<- APR[SURV]
}

record=function(){
  list(PRE_TOSSRSLT=TOSSRSLT, SURV=SURV, STAGE=STAGE, PLAYER=PLAYER)
}

go= function(){
  PROB<- 0.5+(PLAYER=='A')*0.45
  TOSSRSLT<-toss(PROB)
  if (TOSSRSLT==FALSE) SURV<-SURV-1
  STAGE<-STAGE+1
  PLAYER<-APR[SURV]
}

gogo=function(){
  for(i in 1:20){
    go()
    if (SURV==0) break
  }
}

gogo_history=function() {
  rslt_=as_tibble(record())
  for(i in 1:20){
    go()
    rslt_=rbind(rslt_,as_tibble(record()))
  }
  print(rslt_)
}

simulate_once=function(){
  reset()
  gogo()
  return(record()$SURV)
}

```

```

simrslt=c()
for (i in 1:1000) simrslt[i]=simulate_once()
mean(simrslt)

```

```
## [1] 5.554
```

### 3번(B)

```

APR=c('N10','A','N8','N7','N6','N5','N4','N3','N2','N1')
SURV=10
PLAYER=APR[SURV]
STAGE=0
PROB=0.5
TOSSRSLT=NA
library(tidyverse)

toss=function(p) rbinom(n=1,size=1,prob=p) %>% as.logical

reset=function(){
  TOSSRSLT<-NA
  SURV<- 10
  STAGE<- 0
  PLAYER<- APR[SURV]
}

record=function(){
  list(PRE_TOSSRSLT=TOSSRSLT, SURV=SURV, STAGE=STAGE, PLAYER=PLAYER)
}

go= function(){
  PROB<-0.5+(PLAYER=='A')*0.45
  TOSSRSLT<-toss(PROB)
  if (TOSSRSLT==FALSE) SURV<-SURV-1
  STAGE<-STAGE+1
  PLAYER<-APR[SURV]
}

gogo=function(){
  for(i in 1:20){
    go()
    if (SURV==0) break
  }
}

```

```

gogo_history=function() {
  rslt_=as_tibble(record())
  for(i in 1:20){
    go()
    rslt_=rbind(rslt_,as_tibble(record()))
  }
  print(rslt_)
}

simulate_once=function(){
  reset()
  gogo()
  return(record())$SURV
}

simrslt=c()
for (i in 1:1000) simrslt[i]=simulate_once()
mean(simrslt)

```

```
## [1] 1.866
```

**TYPE A 에서 살아남을 확률 계산결과**

**TYPE B 에서 살아남을 확률 계산결과**

**따라서 TYPE A에서 살아남을 확률이 더 크다**

**4번**

```

df=read_csv('https://raw.githubusercontent.com/guebin/2021IR/master/_notebooks/covid19.c
## Rows: 12294 Columns: 5
## -- Column specification -----
## Delimiter: ","
## chr (1): prov
## dbl (4): year, month, day, cases
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
head(df)

## # A tibble: 6 x 5
##   year month   day prov cases
##   <dbl> <dbl> <dbl> <chr> <dbl>

```

```
## 1 2020      1    20 서울      0
## 2 2020      1    20 부산      0
## 3 2020      1    20 대구      0
## 4 2020      1    20 인천      1
## 5 2020      1    20 광주      0
## 6 2020      1    20 대전      0
```

```
df = as_tibble(df)
df %>% group_by(year)
```

```
## # A tibble: 12,294 x 5
## # Groups:   year [2]
##   year month   day prov  cases
##   <dbl> <dbl> <dbl> <chr> <dbl>
## 1 2020      1    20 서울      0
## 2 2020      1    20 부산      0
## 3 2020      1    20 대구      0
## 4 2020      1    20 인천      1
## 5 2020      1    20 광주      0
## 6 2020      1    20 대전      0
## 7 2020      1    20 울산      0
## 8 2020      1    20 세종      0
## 9 2020      1    20 경기      0
## 10 2020      1    20 강원      0
## # ... with 12,284 more rows
```

### ## 2020년 확진자 수

```
df %>% filter(year==2020) %>% summarise(sum_cases=sum(cases))
```

```
## # A tibble: 1 x 1
##   sum_cases
##   <dbl>
## 1     60726
```

### ## 2021년 확진자 수

```
df %>% filter(year==2021) %>% summarise(sum_cases=sum(cases))
```

```
## # A tibble: 1 x 1
##   sum_cases
##   <dbl>
## 1    396886
```

### ## 4-(2)번

```
df %>% filter(year==2020 & month==2 & day<=15) %>% group_by(prov) %>% summarise(confirm=
```

```
## # A tibble: 18 x 2
```

```
##      prov  confirm
##      <chr>    <dbl>
##  1 강원      0
##  2 검역      0
##  3 경기      9
##  4 경남      0
##  5 경북      0
##  6 광주      2
##  7 대구      0
##  8 대전      0
##  9 부산      0
## 10 서울      5
## 11 세종      0
## 12 울산      0
## 13 인천      0
## 14 전남      1
## 15 전북      0
## 16 제주      0
## 17 충남      0
## 18 충북      0
```

**2020년 2월 1일~15일 가장많은 확진자가 발견된 지역은 경기(9명)**

##4-(3)번

```
df %>% filter(year==2020 & month==2 & day>=16 & day <= 29) %>% group_by(prov) %>% summar
```

```
## # A tibble: 18 x 2
##      prov  confirm
##      <chr>    <dbl>
##  1 강원      7
##  2 검역      0
##  3 경기     65
##  4 경남     59
##  5 경북    472
##  6 광주      7
##  7 대구    2055
##  8 대전     13
##  9 부산     75
## 10 서울     62
## 11 세종      1
## 12 울산    17
## 13 인천      5
## 14 전남      1
## 15 전북      4
```

```
## 16 제주          2
## 17 충남          48
## 18 충북          10
```

## 2020년 2월 16일 ~ 29일 까지 가장 많은 확진자가 발견된 지역은 대구(2055명)

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When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

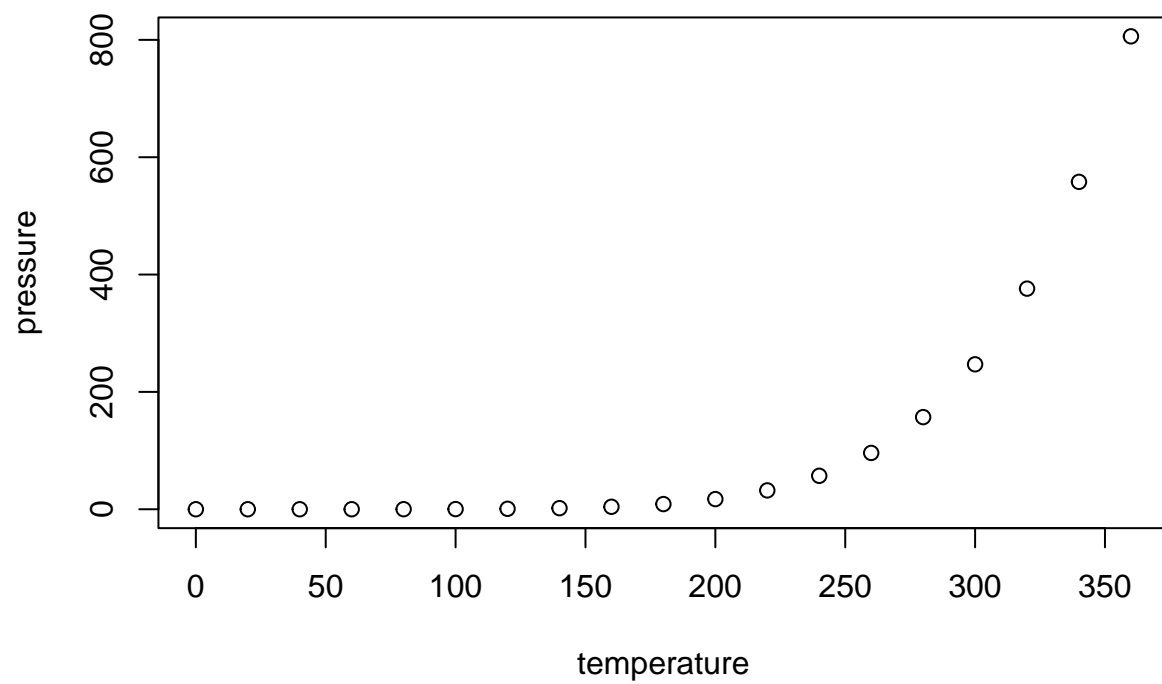
```
summary(cars)
```

```
##      speed      dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean    : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.    :120.00
```

## Including Plots

You can also embed plots, for example:





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