

Food Web Comparisons

2024-06-25

```
nodes <- read_csv("data/foodweb_V6/trophic_nodes.csv")
```

```
## Rows: 1809 Columns: 26
## -- Column specification -----
## Delimiter: ","
## chr (23): node, nodeName, synonymies, category, common_name, life_stage, pro...
## dbl (3): nodeNum, life_stage_code, aphia
##
## 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.
```

```
links <- read_csv("data/foodweb_V6/trophic_links.csv")
```

```
## Rows: 13556 Columns: 18
## -- Column specification -----
## Delimiter: ","
## chr (11): resource, resourceName, resourceCat, consumer, consumerName, consu...
## dbl (7): resourceNum, resourceStage, consumerNum, consumerStage, interactio...
##
## 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.
```

Time to compare foodwebs!

Let's start with parasites vs no parasites

First make subweb data

```
#####
##### NO PARASITES #####
#####

##### filter parasites out to create new node list #####
nodes_nopsites <- nodes %>%
  filter(parasite == "n")

##### subset the web using this new node list #####
# we only want consumers/resource links in the web if those consumers/resources are in our clean node l
# we can do this in five steps
```

```

#1. create a "keep" list of consumers
consumers_keep <- nodes_nopsites %>%
  dplyr::select(node) %>% # we only need the unique identifier, "node", for matching
  rename(consumer = node) # the unique identifier of consumers in the link list is "consumer", and thes

#2. create a version of the link list that only has links with consumers in our "keep" list, e.g. free
consumer_keep_links <- inner_join(consumers_keep, links, by = join_by(consumer)) # inner join keeps onl

#3. create a "keep" list of resources (this is identical to our consumer keep list, we just need to cha
resources_keep <- consumers_keep %>%
  rename(resource = consumer) # the unique identifier of resources in the link list is "resource", and

#4. use 'inner_join()' to create a link list from the consumer_keep_links list that ALSO only has resou
links_nopsites <- inner_join(resources_keep, consumer_keep_links, by = join_by(resource))

```

Then make cheddar and igraph objects

```

##### CHEDDAR #####

## with parasites ##
# create properties list
properties.p <- list(title = "ca riz parasites") #syntax that the help doc suggests

# create community object
ca_riz_parasites <- Community(nodes = nodes, properties.p, trophic.links = links)
ca_riz_parasites

```

ca riz parasites containing 1809 nodes and 13556 trophic links

```

## no parasites ##

# create properties list
properties.np <- list(title = "ca riz no parasites") #syntax that the help doc suggests

# create community object
ca_riz_freeliving <- Community(nodes = nodes_nopsites, properties.np, trophic.links = links_nopsites)
ca_riz_freeliving

```

ca riz no parasites containing 1462 nodes and 12712 trophic links

```

##### IGRAPH #####

## with parasites ##
igraph_links <- links %>%
  relocate(consumer, .after = resource)

igraph_psites <- graph_from_data_frame(d= igraph_links, # all links
                                     vertices = nodes,
                                     directed=T) # this makes sure resources (from) "point" to consumers (to)

```

```
## no parasites ##
igraph_links_np <- links_nopsites %>%
  relocate(consumer, .after = resource)

igraph_nopsites <- graph_from_data_frame(d= igraph_links_np, # all links
  vertices = nodes_nopsites,
  directed=T) # this makes sure resources (from) "point" to consumers (to)
```

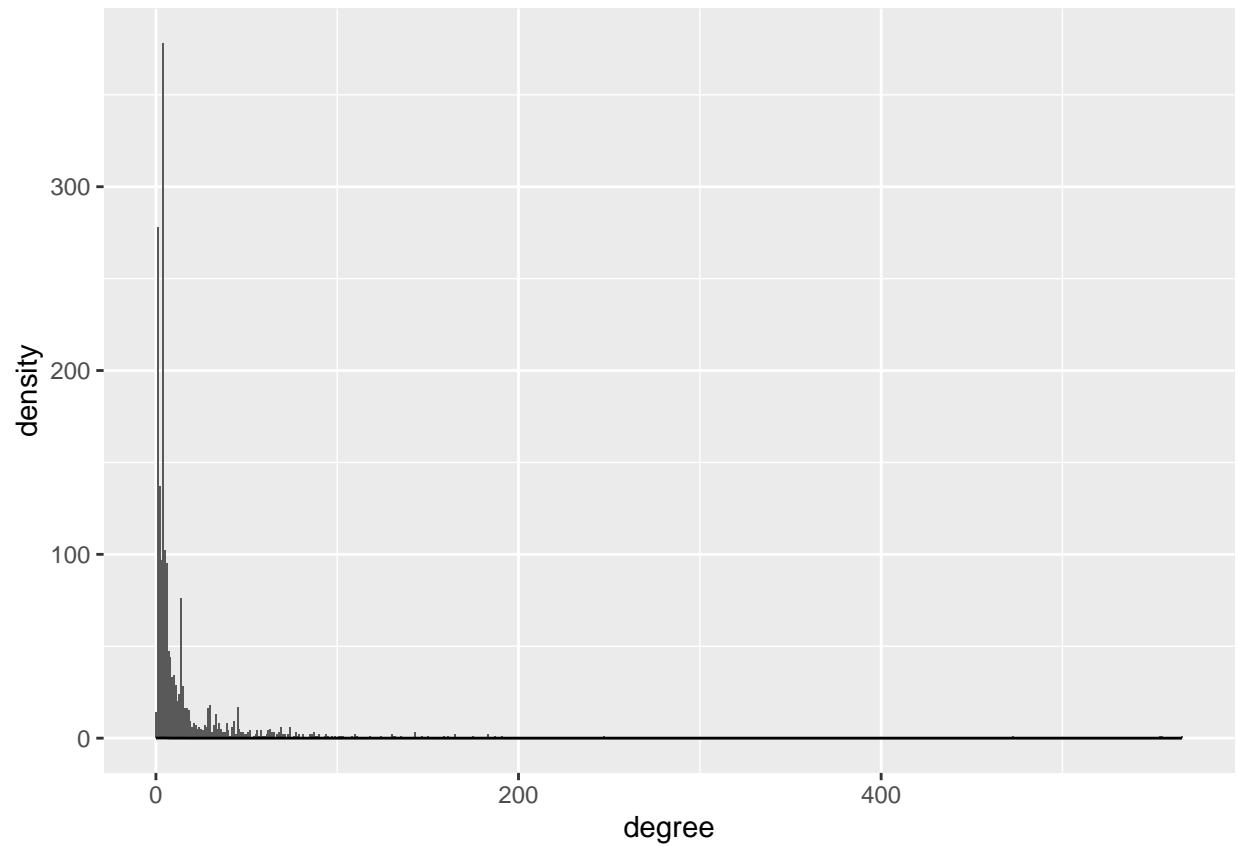
I would first like to visualize degree (# links/node) distribution (PDF) and cumulative distribution (eCDF) for each web

```
# create degree and add it to nodes dfs:
deg.p <- igraph::degree(igraph_psites, mode = "all")
nodes <- nodes %>%
  mutate(degree = deg.p)

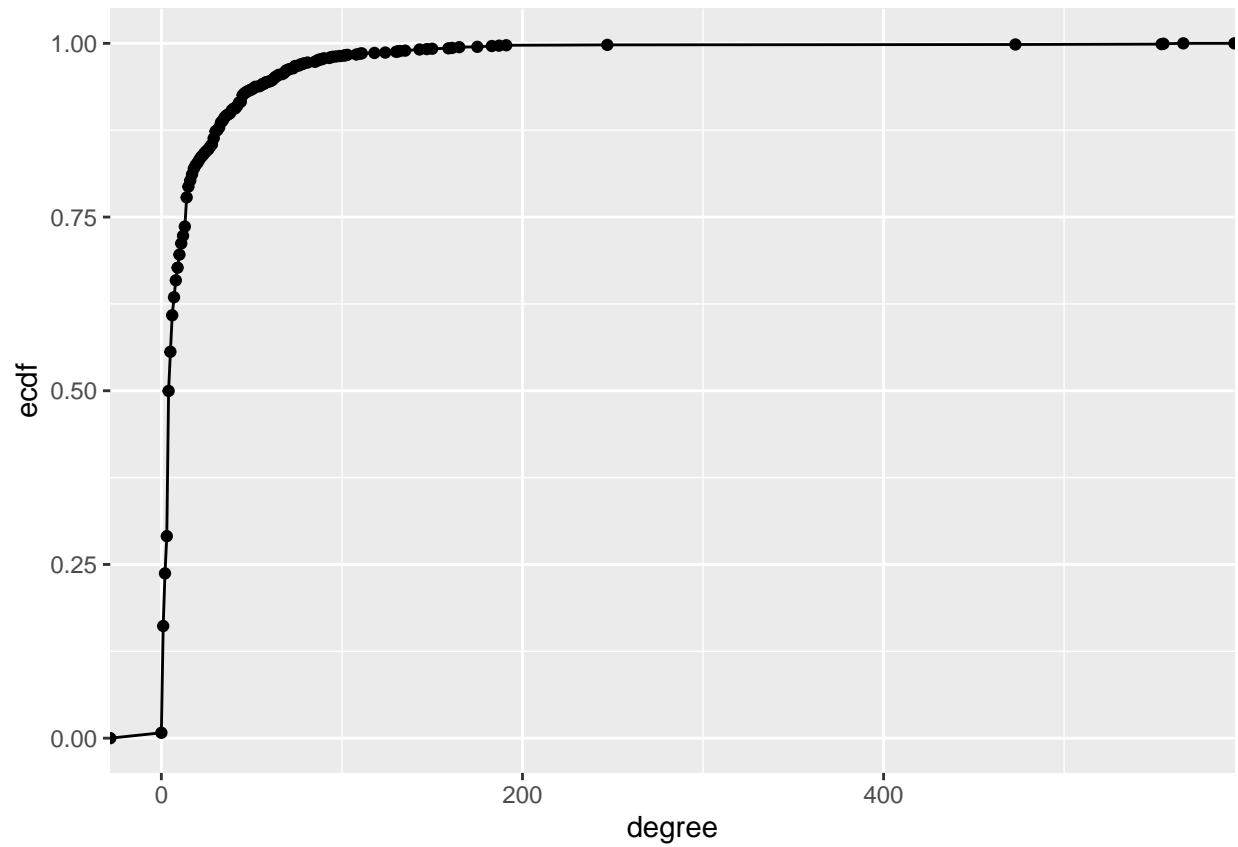
deg.np <- igraph::degree(igraph_nopsites, mode = "all")
nodes_nopsites <- nodes_nopsites %>%
  mutate(degree = deg.np)

# plot degree PDF for parasites web

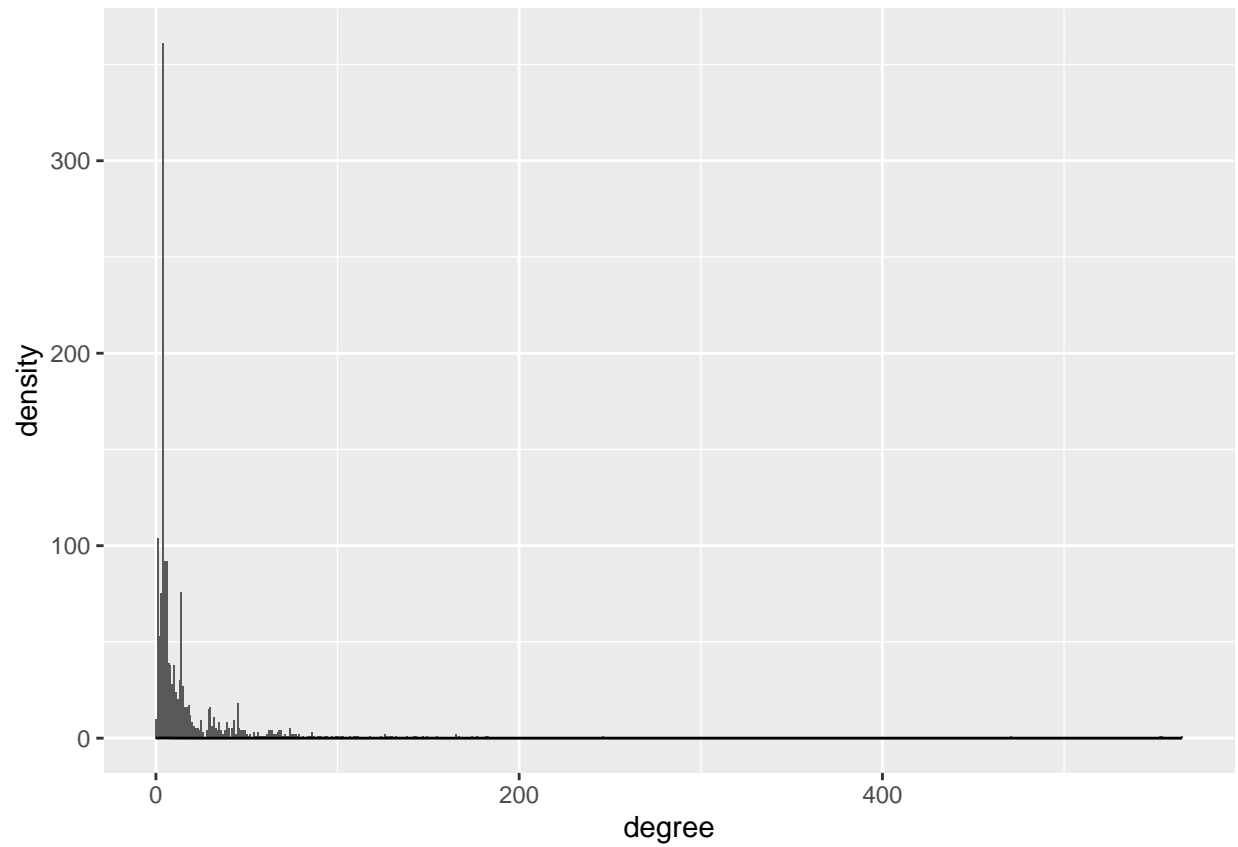
ggplot(nodes, aes(x = degree)) +
  geom_histogram(binwidth = 1) +
  geom_density()
```



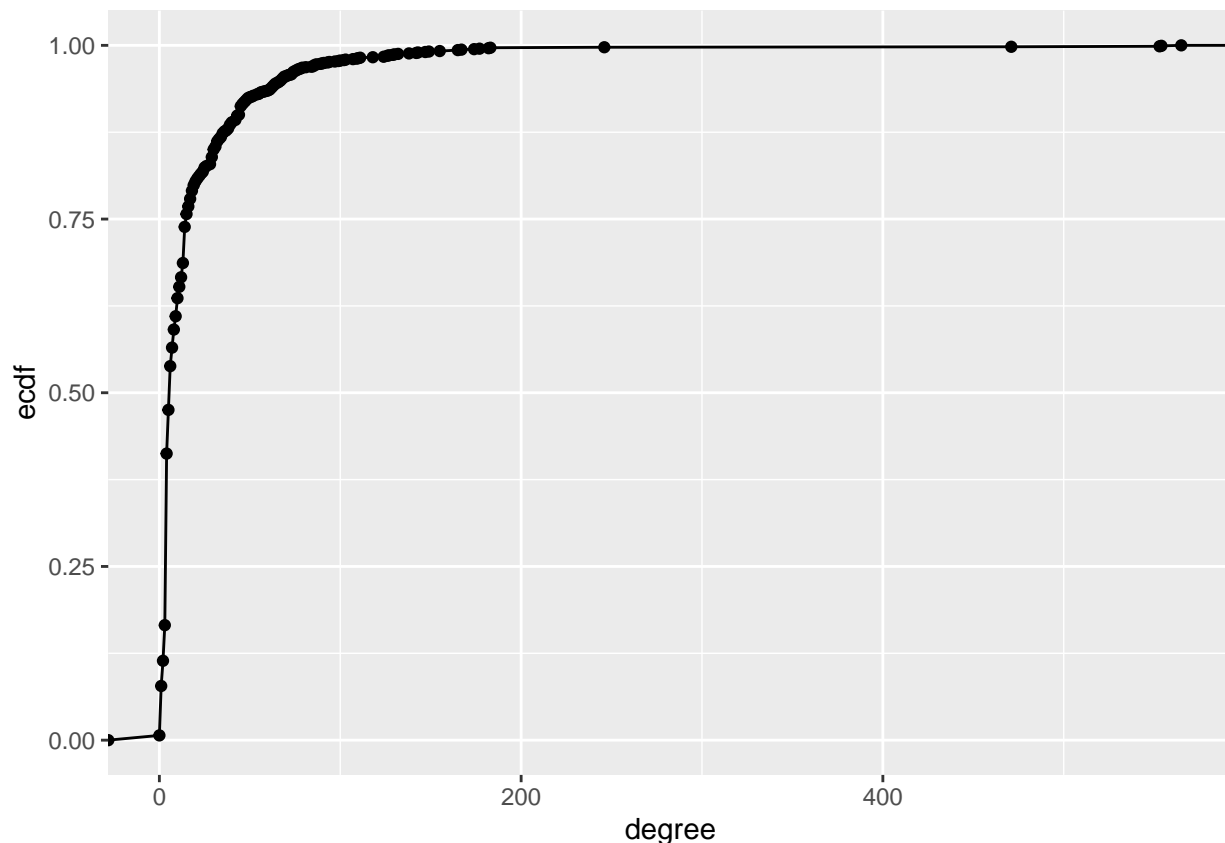
```
# plot degree eCDF for parasites web  
ggplot(nodes, aes(x = degree)) +  
  geom_line(stat = "ecdf")+  
  geom_point(stat = "ecdf")
```



```
# plot degree PDF for no parasites web  
ggplot(nodes_nopsites, aes(x = degree)) +  
  geom_histogram(binwidth = 1) +  
  geom_density()
```



```
# plot degree eCDF for no parasites web  
ggplot(nodes_nopsites, aes(x = degree)) +  
  geom_line(stat = "ecdf")+  
  geom_point(stat = "ecdf")
```



```
# turns out package NetworkExtinction has a really nice function for this as well (oh oops so does igraph)
# parasites #
psites_adj<- as.network(as_adjacency_matrix(igraph_psites), matrix.type = "adjacency")
```

```
NetworkExtinction::DegreeDistribution(psites_adj)
```

```
## Could not fit Exponential model: number of iterations exceeded maximum of 50
```

```
## Joining with 'by = join_by(K, Cumulative, LogK, LogCum)'
## Joining with 'by = join_by(K, Cumulative, LogK, LogCum, LogExp, LogPower)'
## Joining with 'by = join_by(logLik, AIC, BIC, deviance, df.residual, nobs,
## model, Normal.Resid, family, AICcNorm)'
## Joining with 'by = join_by(logLik, AIC, BIC, deviance, df.residual, nobs,
## model, Normal.Resid, family, AICcNorm, null.deviance, df.null)'
```

```
## $DDvalues
```

	K	Cumulative	LogK	LogCum	LogExp	LogPower
## 1	0	0.9922609176	-Inf	-0.007769184	NA	NA
## 2	1	0.8341625207	0.0000000	-0.181327027	0.0401373581	10.264748728
## 3	2	0.7578772803	0.6931472	-0.277233806	0.0398375600	3.801467370
## 4	3	0.7037037037	1.0986123	-0.351397887	0.0395400012	2.126180676
## 5	4	0.4930901050	1.3862944	-0.707063353	0.0392446650	1.407842954
## 6	5	0.4372581537	1.6094379	-0.827231518	0.0389515348	1.022528400
## 7	6	0.3830845771	1.7917595	-0.959499486	0.0386605940	0.787413962
## 8	7	0.3615257048	1.9459101	-1.017422134	0.0383718263	0.631340537

## 9	8	0.3355444997	2.0794415	-1.092000694	0.0380852155	0.521383347
## 10	9	0.3173023770	2.1972246	-1.147900089	0.0378007456	0.440404766
## 11	10	0.3012714207	2.3025851	-1.199743691	0.0375184004	0.378685193
## 12	11	0.2846876727	2.3978953	-1.256362585	0.0372381641	0.330338892
## 13	12	0.2725262576	2.4849066	-1.300020311	0.0369600210	0.291612446
## 14	13	0.2592592593	2.5649494	-1.349926717	0.0366839554	0.260009684
## 15	14	0.2177998894	2.6390573	-1.524178576	0.0364099519	0.233811905
## 16	15	0.2012161415	2.7080502	-1.603375618	0.0361379949	0.211800618
## 17	16	0.1923714760	2.7725887	-1.648327006	0.0358680693	0.193090141
## 18	17	0.1857379768	2.8332133	-1.683418325	0.0356001599	0.177022671
## 19	18	0.1779988944	2.8903718	-1.725977940	0.0353342515	0.163100373
## 20	19	0.1735765616	2.9444390	-1.751136499	0.0350703293	0.150940193
## 21	20	0.1702598121	2.9957323	-1.770429702	0.0348083784	0.140243024
## 22	21	0.1652846877	3.0445224	-1.800085912	0.0345483841	0.130772227
## 23	22	0.1608623549	3.0910425	-1.827206218	0.0342903318	0.122338360
## 24	23	0.1592039801	3.1354942	-1.837569005	0.0340342070	0.114788139
## 25	24	0.1564400221	3.1780538	-1.855082588	0.0337799952	0.107996331
## 26	25	0.1542288557	3.2188758	-1.869317704	0.0335276822	0.101859710
## 27	26	0.1520176893	3.2580965	-1.883758388	0.0332772538	0.096292501
## 28	27	0.1481481481	3.2958369	-1.909542505	0.0330286959	0.091222896
## 29	28	0.1448313986	3.3322045	-1.932184982	0.0327819946	0.086590364
## 30	29	0.1354339414	3.3672958	-1.999271275	0.0325371360	0.082343557
## 31	30	0.1254836926	3.4011974	-2.075579468	0.0322941063	0.078438660
## 32	31	0.1216141515	3.4339872	-2.106901939	0.0320528919	0.074838077
## 33	32	0.1182974019	3.4657359	-2.134553470	0.0318134791	0.071509385
## 34	33	0.1100055279	3.4965076	-2.207224661	0.0315758546	0.068424487
## 35	34	0.1077943615	3.5263605	-2.227529927	0.0313400050	0.065558926
## 36	35	0.1050304035	3.5553481	-2.253505413	0.0311059171	0.062891323
## 37	36	0.1028192371	3.5835189	-2.274782812	0.0308735776	0.060402915
## 38	37	0.0983969044	3.6109179	-2.318745935	0.0306429735	0.058077175
## 39	38	0.0961857380	3.6375862	-2.341474186	0.0304140918	0.055899490
## 40	39	0.0945273632	3.6635616	-2.358865929	0.0301869198	0.053856902
## 41	40	0.0939745716	3.6888795	-2.364731048	0.0299614446	0.051937879
## 42	41	0.0928689884	3.7135721	-2.376565506	0.0297376535	0.050132131
## 43	42	0.0889994472	3.7376696	-2.419125120	0.0295155340	0.048430445
## 44	43	0.0796019900	3.7612001	-2.530716186	0.0292950735	0.046824558
## 45	44	0.0773908237	3.7841896	-2.558887063	0.0290762598	0.045307030
## 46	45	0.0735212825	3.8066625	-2.610180357	0.0288590804	0.043871155
## 47	46	0.0713101161	3.8286414	-2.640717081	0.0286435232	0.042510867
## 48	47	0.0690989497	3.8501476	-2.672215748	0.0284295761	0.041220670
## 49	48	0.0679933665	3.8712010	-2.688345130	0.0282172270	0.039995575
## 50	49	0.0668877833	3.8918203	-2.704738940	0.0280064640	0.038831041
## 51	50	0.0657822001	3.9120230	-2.721405992	0.0277972752	0.037722927
## 52	51	0.0641238253	3.9318256	-2.746939294	0.0275896490	0.036667452
## 53	52	0.0624654505	3.9512437	-2.773141667	0.0273835736	0.035661156
## 54	53	0.0619126589	3.9702919	-2.782030614	0.0271790374	0.034700865
## 55	54	0.0597014925	3.9889840	-2.818398258	0.0269760289	0.033783668
## 56	55	0.0591487009	4.0073332	-2.827700651	0.0267745368	0.032906884
## 57	56	0.0574903261	4.0253517	-2.856138586	0.0265745497	0.032068047
## 58	57	0.0574903261	4.0430513	-2.856138586	0.0263760564	0.031264878
## 59	58	0.0558319514	4.0604430	-2.885408969	0.0261790456	0.030495276
## 60	59	0.0530679934	4.0775374	-2.936181294	0.0259835064	0.029757294
## 61	60	0.0508568270	4.0943446	-2.978740908	0.0257894278	0.029049129
## 62	61	0.0503040354	4.1108739	-2.989669979	0.0255967987	0.028369109

## 63	62	0.0475400774	4.1271344	-3.046182189	0.0254056085	0.027715682
## 64	63	0.0469872858	4.1431347	-3.057878229	0.0252158463	0.027087403
## 65	64	0.0464344942	4.1588831	-3.069712687	0.0250275016	0.026482927
## 66	65	0.0442233278	4.1743873	-3.118502851	0.0248405636	0.025901003
## 67	66	0.0431177446	4.1896547	-3.143820659	0.0246550219	0.025340460
## 68	67	0.0409065782	4.2046926	-3.196464392	0.0244708661	0.024800207
## 69	68	0.0403537866	4.2195077	-3.210070044	0.0242880858	0.024279223
## 70	69	0.0381426202	4.2341065	-3.266422981	0.0241066707	0.023776551
## 71	70	0.0370370370	4.2484952	-3.295836866	0.0239266107	0.023291297
## 72	71	0.0364842454	4.2626799	-3.310874743	0.0237478956	0.022822621
## 73	72	0.0331674959	4.2766661	-3.406184923	0.0235705154	0.022369735
## 74	73	0.0320619127	4.2904594	-3.440086475	0.0233944601	0.021931899
## 75	74	0.0315091211	4.3040651	-3.457478218	0.0232197198	0.021508416
## 76	75	0.0298507463	4.3174881	-3.511545439	0.0230462847	0.021098631
## 77	76	0.0298507463	4.3307333	-3.511545439	0.0228741451	0.020701928
## 78	77	0.0298507463	4.3438054	-3.511545439	0.0227032912	0.020317724
## 79	78	0.0287451631	4.3567088	-3.549285767	0.0225337134	0.019945472
## 80	79	0.0287451631	4.3694479	-3.549285767	0.0223654023	0.019584652
## 81	80	0.0281923715	4.3820266	-3.568703853	0.0221983484	0.019234777
## 82	81	0.0276395799	4.3944492	-3.588506480	0.0220325422	0.018895383
## 83	82	0.0276395799	4.4067192	-3.588506480	0.0218679745	0.018566033
## 84	83	0.0276395799	4.4188406	-3.588506480	0.0217046360	0.018246311
## 85	84	0.0265339967	4.4308168	-3.629328474	0.0215425175	0.017935827
## 86	85	0.0254284135	4.4426513	-3.671888089	0.0213816099	0.017634207
## 87	86	0.0243228303	4.4543473	-3.716339851	0.0212219042	0.017341099
## 88	87	0.0232172471	4.4659081	-3.762859867	0.0210633914	0.017056168
## 89	88	0.0226644555	4.4773368	-3.786957419	0.0209060625	0.016779095
## 90	89	0.0221116639	4.4886364	-3.811650031	0.0207499088	0.016509579
## 91	90	0.0215588723	4.4998097	-3.836967839	0.0205949215	0.016247330
## 92	91	0.0215588723	4.5108595	-3.836967839	0.0204410918	0.015992077
## 93	92	0.0210060807	4.5217886	-3.862943326	0.0202884111	0.015743559
## 94	93	0.0193477059	4.5325995	-3.945181424	0.0201368708	0.015501526
## 95	94	0.0193477059	4.5432948	-3.945181424	0.0199864625	0.015265745
## 96	95	0.0193477059	4.5538769	-3.945181424	0.0198371775	0.015035988
## 97	96	0.0193477059	4.5643482	-3.945181424	0.0196890077	0.014812040
## 98	97	0.0182421227	4.5747110	-4.004021924	0.0195419445	0.014593698
## 99	98	0.0182421227	4.5849675	-4.004021924	0.0193959798	0.014380764
## 100	99	0.0182421227	4.5951199	-4.004021924	0.0192511054	0.014173053
## 101	100	0.0182421227	4.6051702	-4.004021924	0.0191073131	0.013970383
## 102	101	0.0171365395	4.6151205	-4.066542281	0.0189645948	0.013772586
## 103	102	0.0171365395	4.6249728	-4.066542281	0.0188229425	0.013579497
## 104	103	0.0165837479	4.6347290	-4.099332104	0.0186823482	0.013390959
## 105	104	0.0165837479	4.6443909	-4.099332104	0.0185428041	0.013206823
## 106	105	0.0165837479	4.6539604	-4.099332104	0.0184043023	0.013026945
## 107	106	0.0165837479	4.6634391	-4.099332104	0.0182668350	0.012851187
## 108	107	0.0165837479	4.6728288	-4.099332104	0.0181303945	0.012679418
## 109	108	0.0154781647	4.6821312	-4.168324975	0.0179949731	0.012511510
## 110	109	0.0149253731	4.6913479	-4.204692619	0.0178605632	0.012347344
## 111	110	0.0143725815	4.7004804	-4.242432947	0.0177271573	0.012186801
## 112	111	0.0143725815	4.7095302	-4.242432947	0.0175947478	0.012029770
## 113	112	0.0143725815	4.7184989	-4.242432947	0.0174633273	0.011876144
## 114	113	0.0143725815	4.7273878	-4.242432947	0.0173328884	0.011725819
## 115	114	0.0143725815	4.7361984	-4.242432947	0.0172034238	0.011578697
## 116	115	0.0143725815	4.7449321	-4.242432947	0.0170749263	0.011434681

##	117	116	0.0138197899	4.7535902	-4.281653661	0.0169473885	0.011293681
##	118	117	0.0138197899	4.7621739	-4.281653661	0.0168208033	0.011155607
##	119	118	0.0138197899	4.7706846	-4.281653661	0.0166951637	0.011020375
##	120	119	0.0138197899	4.7791235	-4.281653661	0.0165704624	0.010887903
##	121	120	0.0138197899	4.7874917	-4.281653661	0.0164466926	0.010758112
##	122	121	0.0138197899	4.7957905	-4.281653661	0.0163238473	0.010630926
##	123	122	0.0138197899	4.8040210	-4.281653661	0.0162019196	0.010506272
##	124	123	0.0138197899	4.8121844	-4.281653661	0.0160809025	0.010384080
##	125	124	0.0132669983	4.8202816	-4.322475655	0.0159607894	0.010264280
##	126	125	0.0132669983	4.8283137	-4.322475655	0.0158415735	0.010146809
##	127	126	0.0132669983	4.8362819	-4.322475655	0.0157232480	0.010031602
##	128	127	0.0132669983	4.8441871	-4.322475655	0.0156058063	0.009918599
##	129	128	0.0127142067	4.8520303	-4.365035269	0.0154892418	0.009807740
##	130	129	0.0127142067	4.8598124	-4.365035269	0.0153735480	0.009698968
##	131	130	0.0121614151	4.8675345	-4.409487032	0.0152587183	0.009592229
##	132	131	0.0116086235	4.8751973	-4.456007048	0.0151447463	0.009487469
##	133	132	0.0110558320	4.8828019	-4.504797212	0.0150316256	0.009384636
##	134	133	0.0110558320	4.8903491	-4.504797212	0.0149193499	0.009283682
##	135	134	0.0110558320	4.8978398	-4.504797212	0.0148079127	0.009184558
##	136	135	0.0105030404	4.9052748	-4.556090506	0.0146973079	0.009087217
##	137	136	0.0105030404	4.9126549	-4.556090506	0.0145875293	0.008991615
##	138	137	0.0105030404	4.9199809	-4.556090506	0.0144785706	0.008897709
##	139	138	0.0105030404	4.9272537	-4.556090506	0.0143704258	0.008805455
##	140	139	0.0105030404	4.9344739	-4.556090506	0.0142630888	0.008714814
##	141	140	0.0105030404	4.9416424	-4.556090506	0.0141565534	0.008625745
##	142	141	0.0099502488	4.9487599	-4.610157727	0.0140508139	0.008538211
##	143	142	0.0099502488	4.9558271	-4.610157727	0.0139458641	0.008452175
##	144	143	0.0088446656	4.9628446	-4.727940763	0.0138416982	0.008367600
##	145	144	0.0082918740	4.9698133	-4.792479284	0.0137383104	0.008284452
##	146	145	0.0082918740	4.9767337	-4.792479284	0.0136356948	0.008202697
##	147	146	0.0082918740	4.9836066	-4.792479284	0.0135338457	0.008122303
##	148	147	0.0082918740	4.9904326	-4.792479284	0.0134327573	0.008043237
##	149	148	0.0082918740	4.9972123	-4.792479284	0.0133324240	0.007965469
##	150	149	0.0082918740	5.0039463	-4.792479284	0.0132328401	0.007888970
##	151	150	0.0077390824	5.0106353	-4.861472156	0.0131340000	0.007813709
##	152	151	0.0077390824	5.0172798	-4.861472156	0.0130358982	0.007739659
##	153	152	0.0077390824	5.0238805	-4.861472156	0.0129385291	0.007666793
##	154	153	0.0077390824	5.0304379	-4.861472156	0.0128418873	0.007595084
##	155	154	0.0077390824	5.0369526	-4.861472156	0.0127459674	0.007524506
##	156	155	0.0077390824	5.0434251	-4.861472156	0.0126507639	0.007455035
##	157	156	0.0077390824	5.0498560	-4.861472156	0.0125562715	0.007386645
##	158	157	0.0077390824	5.0562458	-4.861472156	0.0124624849	0.007319315
##	159	158	0.0071862908	5.0625950	-4.935580128	0.0123693989	0.007253019
##	160	159	0.0071862908	5.0689042	-4.935580128	0.0122770081	0.007187737
##	161	160	0.0066334992	5.0751738	-5.015622836	0.0121853074	0.007123445
##	162	161	0.0066334992	5.0814044	-5.015622836	0.0120942917	0.007060125
##	163	162	0.0066334992	5.0875963	-5.015622836	0.0120039557	0.006997754
##	164	163	0.0066334992	5.0937502	-5.015622836	0.0119142946	0.006936312
##	165	164	0.0066334992	5.0998664	-5.015622836	0.0118253031	0.006875781
##	166	165	0.0055279160	5.1059455	-5.197944392	0.0117369763	0.006816142
##	167	166	0.0055279160	5.1119878	-5.197944392	0.0116493093	0.006757375
##	168	167	0.0055279160	5.1179938	-5.197944392	0.0115622971	0.006699464
##	169	168	0.0055279160	5.1239640	-5.197944392	0.0114759348	0.006642390
##	170	169	0.0055279160	5.1298987	-5.197944392	0.0113902176	0.006586136

##	171	170	0.0055279160	5.1357984	-5.197944392	0.0113051406	0.006530687
##	172	171	0.0055279160	5.1416636	-5.197944392	0.0112206991	0.006476026
##	173	172	0.0055279160	5.1474945	-5.197944392	0.0111368883	0.006422137
##	174	173	0.0055279160	5.1532916	-5.197944392	0.0110537035	0.006369005
##	175	174	0.0055279160	5.1590553	-5.197944392	0.0109711401	0.006316615
##	176	175	0.0049751244	5.1647860	-5.303304908	0.0108891933	0.006264953
##	177	176	0.0049751244	5.1704840	-5.303304908	0.0108078586	0.006214003
##	178	177	0.0049751244	5.1761497	-5.303304908	0.0107271315	0.006163754
##	179	178	0.0049751244	5.1817836	-5.303304908	0.0106470073	0.006114190
##	180	179	0.0049751244	5.1873858	-5.303304908	0.0105674816	0.006065299
##	181	180	0.0049751244	5.1929569	-5.303304908	0.0104885499	0.006017069
##	182	181	0.0049751244	5.1984970	-5.303304908	0.0104102077	0.005969485
##	183	182	0.0044223328	5.2040067	-5.421087944	0.0103324507	0.005922538
##	184	183	0.0038695412	5.2094862	-5.554619336	0.0102552745	0.005876213
##	185	184	0.0038695412	5.2149358	-5.554619336	0.0101786748	0.005830501
##	186	185	0.0038695412	5.2203558	-5.554619336	0.0101026472	0.005785389
##	187	186	0.0038695412	5.2257467	-5.554619336	0.0100271874	0.005740866
##	188	187	0.0033167496	5.2311086	-5.708770016	0.0099522914	0.005696922
##	189	188	0.0033167496	5.2364420	-5.708770016	0.0098779547	0.005653546
##	190	189	0.0033167496	5.2417470	-5.708770016	0.0098041733	0.005610728
##	191	190	0.0033167496	5.2470241	-5.708770016	0.0097309429	0.005568457
##	192	191	0.0027639580	5.2522734	-5.891091573	0.0096582596	0.005526725
##	193	192	0.0027639580	5.2574954	-5.891091573	0.0095861191	0.005485520
##	194	193	0.0027639580	5.2626902	-5.891091573	0.0095145175	0.005444835
##	195	194	0.0027639580	5.2678582	-5.891091573	0.0094434507	0.005404659
##	196	195	0.0027639580	5.2729996	-5.891091573	0.0093729147	0.005364984
##	197	196	0.0027639580	5.2781147	-5.891091573	0.0093029056	0.005325801
##	198	197	0.0027639580	5.2832037	-5.891091573	0.0092334193	0.005287101
##	199	198	0.0027639580	5.2882670	-5.891091573	0.0091644521	0.005248876
##	200	199	0.0027639580	5.2933048	-5.891091573	0.0090960001	0.005211118
##	201	200	0.0027639580	5.2983174	-5.891091573	0.0090280593	0.005173819
##	202	201	0.0027639580	5.3033049	-5.891091573	0.0089606260	0.005136971
##	203	202	0.0027639580	5.3082677	-5.891091573	0.0088936964	0.005100567
##	204	203	0.0027639580	5.3132060	-5.891091573	0.0088272667	0.005064598
##	205	204	0.0027639580	5.3181200	-5.891091573	0.0087613332	0.005029058
##	206	205	0.0027639580	5.3230100	-5.891091573	0.0086958921	0.004993939
##	207	206	0.0027639580	5.3278762	-5.891091573	0.0086309399	0.004959234
##	208	207	0.0027639580	5.3327188	-5.891091573	0.0085664728	0.004924937
##	209	208	0.0027639580	5.3375381	-5.891091573	0.0085024872	0.004891041
##	210	209	0.0027639580	5.3423343	-5.891091573	0.0084389795	0.004857539
##	211	210	0.0027639580	5.3471075	-5.891091573	0.0083759463	0.004824425
##	212	211	0.0027639580	5.3518581	-5.891091573	0.0083133838	0.004791692
##	213	212	0.0027639580	5.3565863	-5.891091573	0.0082512886	0.004759334
##	214	213	0.0027639580	5.3612922	-5.891091573	0.0081896572	0.004727346
##	215	214	0.0027639580	5.3659760	-5.891091573	0.0081284862	0.004695721
##	216	215	0.0027639580	5.3706380	-5.891091573	0.0080677721	0.004664453
##	217	216	0.0027639580	5.3752784	-5.891091573	0.0080075115	0.004633538
##	218	217	0.0027639580	5.3798974	-5.891091573	0.0079477009	0.004602968
##	219	218	0.0027639580	5.3844951	-5.891091573	0.0078883372	0.004572740
##	220	219	0.0027639580	5.3890717	-5.891091573	0.0078294168	0.004542847
##	221	220	0.0027639580	5.3936275	-5.891091573	0.0077709365	0.004513284
##	222	221	0.0027639580	5.3981627	-5.891091573	0.0077128930	0.004484046
##	223	222	0.0027639580	5.4026774	-5.891091573	0.0076552831	0.004455129
##	224	223	0.0027639580	5.4071718	-5.891091573	0.0075981035	0.004426527

##	225	224	0.0027639580	5.4116461	-5.891091573	0.0075413509	0.004398235
##	226	225	0.0027639580	5.4161004	-5.891091573	0.0074850223	0.004370248
##	227	226	0.0027639580	5.4205350	-5.891091573	0.0074291144	0.004342563
##	228	227	0.0027639580	5.4249500	-5.891091573	0.0073736241	0.004315174
##	229	228	0.0027639580	5.4293456	-5.891091573	0.0073185483	0.004288078
##	230	229	0.0027639580	5.4337220	-5.891091573	0.0072638838	0.004261268
##	231	230	0.0027639580	5.4380793	-5.891091573	0.0072096277	0.004234743
##	232	231	0.0027639580	5.4424177	-5.891091573	0.0071557768	0.004208496
##	233	232	0.0027639580	5.4467374	-5.891091573	0.0071023282	0.004182524
##	234	233	0.0027639580	5.4510385	-5.891091573	0.0070492787	0.004156823
##	235	234	0.0027639580	5.4553211	-5.891091573	0.0069966255	0.004131390
##	236	235	0.0027639580	5.4595855	-5.891091573	0.0069443656	0.004106219
##	237	236	0.0027639580	5.4638318	-5.891091573	0.0068924960	0.004081308
##	238	237	0.0027639580	5.4680601	-5.891091573	0.0068410139	0.004056652
##	239	238	0.0027639580	5.4722707	-5.891091573	0.0067899163	0.004032248
##	240	239	0.0027639580	5.4764636	-5.891091573	0.0067392004	0.004008092
##	241	240	0.0027639580	5.4806389	-5.891091573	0.0066888633	0.003984180
##	242	241	0.0027639580	5.4847969	-5.891091573	0.0066389021	0.003960510
##	243	242	0.0027639580	5.4889377	-5.891091573	0.0065893141	0.003937078
##	244	243	0.0027639580	5.4930614	-5.891091573	0.0065400966	0.003913880
##	245	244	0.0027639580	5.4971682	-5.891091573	0.0064912466	0.003890914
##	246	245	0.0027639580	5.5012582	-5.891091573	0.0064427615	0.003868175
##	247	246	0.0027639580	5.5053315	-5.891091573	0.0063946386	0.003845661
##	248	247	0.0022111664	5.5093883	-6.114235124	0.0063468751	0.003823368
##	249	248	0.0022111664	5.5134287	-6.114235124	0.0062994684	0.003801294
##	250	249	0.0022111664	5.5174529	-6.114235124	0.0062524157	0.003779435
##	251	250	0.0022111664	5.5214609	-6.114235124	0.0062057146	0.003757789
##	252	251	0.0022111664	5.5254529	-6.114235124	0.0061593622	0.003736353
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##	254	253	0.0022111664	5.5333895	-6.114235124	0.0060676936	0.003694098
##	255	254	0.0022111664	5.5373343	-6.114235124	0.0060223721	0.003673274
##	256	255	0.0022111664	5.5412635	-6.114235124	0.0059773892	0.003652648
##	257	256	0.0022111664	5.5451774	-6.114235124	0.0059327423	0.003632218
##	258	257	0.0022111664	5.5490761	-6.114235124	0.0058884288	0.003611981
##	259	258	0.0022111664	5.5529596	-6.114235124	0.0058444464	0.003591935
##	260	259	0.0022111664	5.5568281	-6.114235124	0.0058007924	0.003572077
##	261	260	0.0022111664	5.5606816	-6.114235124	0.0057574646	0.003552405
##	262	261	0.0022111664	5.5645204	-6.114235124	0.0057144603	0.003532916
##	263	262	0.0022111664	5.5683445	-6.114235124	0.0056717773	0.003513608
##	264	263	0.0022111664	5.5721540	-6.114235124	0.0056294131	0.003494478
##	265	264	0.0022111664	5.5759491	-6.114235124	0.0055873653	0.003475525
##	266	265	0.0022111664	5.5797298	-6.114235124	0.0055456316	0.003456745
##	267	266	0.0022111664	5.5834963	-6.114235124	0.0055042096	0.003438137
##	268	267	0.0022111664	5.5872487	-6.114235124	0.0054630970	0.003419699
##	269	268	0.0022111664	5.5909870	-6.114235124	0.0054222914	0.003401427
##	270	269	0.0022111664	5.5947114	-6.114235124	0.0053817907	0.003383321
##	271	270	0.0022111664	5.5984220	-6.114235124	0.0053415925	0.003365378
##	272	271	0.0022111664	5.6021188	-6.114235124	0.0053016945	0.003347596
##	273	272	0.0022111664	5.6058021	-6.114235124	0.0052620946	0.003329973
##	274	273	0.0022111664	5.6094718	-6.114235124	0.0052227904	0.003312506
##	275	274	0.0022111664	5.6131281	-6.114235124	0.0051837798	0.003295195
##	276	275	0.0022111664	5.6167711	-6.114235124	0.0051450606	0.003278037
##	277	276	0.0022111664	5.6204009	-6.114235124	0.0051066306	0.003261030
##	278	277	0.0022111664	5.6240175	-6.114235124	0.0050684876	0.003244172

##	279	278	0.0022111664	5.6276211	-6.114235124	0.0050306295	0.003227461
##	280	279	0.0022111664	5.6312118	-6.114235124	0.0049930542	0.003210897
##	281	280	0.0022111664	5.6347896	-6.114235124	0.0049557596	0.003194476
##	282	281	0.0022111664	5.6383547	-6.114235124	0.0049187435	0.003178197
##	283	282	0.0022111664	5.6419071	-6.114235124	0.0048820040	0.003162058
##	284	283	0.0022111664	5.6454469	-6.114235124	0.0048455388	0.003146058
##	285	284	0.0022111664	5.6489742	-6.114235124	0.0048093460	0.003130195
##	286	285	0.0022111664	5.6524892	-6.114235124	0.0047734235	0.003114467
##	287	286	0.0022111664	5.6559918	-6.114235124	0.0047377694	0.003098874
##	288	287	0.0022111664	5.6594822	-6.114235124	0.0047023816	0.003083412
##	289	288	0.0022111664	5.6629605	-6.114235124	0.0046672581	0.003068080
##	290	289	0.0022111664	5.6664267	-6.114235124	0.0046323969	0.003052878
##	291	290	0.0022111664	5.6698809	-6.114235124	0.0045977961	0.003037803
##	292	291	0.0022111664	5.6733233	-6.114235124	0.0045634538	0.003022854
##	293	292	0.0022111664	5.6767538	-6.114235124	0.0045293680	0.003008030
##	294	293	0.0022111664	5.6801726	-6.114235124	0.0044955368	0.002993328
##	295	294	0.0022111664	5.6835798	-6.114235124	0.0044619582	0.002978748
##	296	295	0.0022111664	5.6869754	-6.114235124	0.0044286305	0.002964289
##	297	296	0.0022111664	5.6903595	-6.114235124	0.0043955517	0.002949948
##	298	297	0.0022111664	5.6937321	-6.114235124	0.0043627200	0.002935724
##	299	298	0.0022111664	5.6970935	-6.114235124	0.0043301336	0.002921617
##	300	299	0.0022111664	5.7004436	-6.114235124	0.0042977905	0.002907624
##	301	300	0.0022111664	5.7037825	-6.114235124	0.0042656890	0.002893744
##	302	301	0.0022111664	5.7071103	-6.114235124	0.0042338273	0.002879977
##	303	302	0.0022111664	5.7104270	-6.114235124	0.0042022035	0.002866321
##	304	303	0.0022111664	5.7137328	-6.114235124	0.0041708160	0.002852774
##	305	304	0.0022111664	5.7170277	-6.114235124	0.0041396629	0.002839335
##	306	305	0.0022111664	5.7203118	-6.114235124	0.0041087425	0.002826004
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##	309	308	0.0022111664	5.7300998	-6.114235124	0.0040173602	0.002786641
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##	315	314	0.0022111664	5.7493930	-6.114235124	0.0038406476	0.002710649
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##	317	316	0.0022111664	5.7557422	-6.114235124	0.0037834879	0.002686097
##	318	317	0.0022111664	5.7589018	-6.114235124	0.0037552279	0.002673963
##	319	318	0.0022111664	5.7620514	-6.114235124	0.0037271790	0.002661921
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##	324	323	0.0022111664	5.7776523	-6.114235124	0.0035900458	0.002603068
##	325	324	0.0022111664	5.7807435	-6.114235124	0.0035632307	0.002591562
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##	327	326	0.0022111664	5.7868974	-6.114235124	0.0035101998	0.002568808
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##	329	328	0.0022111664	5.7930136	-6.114235124	0.0034579581	0.002546390
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##	333	332	0.0022111664	5.8051350	-6.114235124	0.0033557957	0.002502540
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##	340	339	0.0022111664	5.8260001	-6.114235124	0.0031842206	0.002428818
##	341	340	0.0022111664	5.8289456	-6.114235124	0.0031604367	0.002418588
##	342	341	0.0022111664	5.8318825	-6.114235124	0.0031368305	0.002408430
##	343	342	0.0022111664	5.8348107	-6.114235124	0.0031134005	0.002398344
##	344	343	0.0022111664	5.8377304	-6.114235124	0.0030901456	0.002388330
##	345	344	0.0022111664	5.8406417	-6.114235124	0.0030670644	0.002378387
##	346	345	0.0022111664	5.8435444	-6.114235124	0.0030441556	0.002368514
##	347	346	0.0022111664	5.8464388	-6.114235124	0.0030214178	0.002358710
##	348	347	0.0022111664	5.8493248	-6.114235124	0.0029988500	0.002348975
##	349	348	0.0022111664	5.8522025	-6.114235124	0.0029764506	0.002339308
##	350	349	0.0022111664	5.8550719	-6.114235124	0.0029542186	0.002329708
##	351	350	0.0022111664	5.8579332	-6.114235124	0.0029321527	0.002320175
##	352	351	0.0022111664	5.8607862	-6.114235124	0.0029102515	0.002310708
##	353	352	0.0022111664	5.8636312	-6.114235124	0.0028885140	0.002301306
##	354	353	0.0022111664	5.8664681	-6.114235124	0.0028669388	0.002291969
##	355	354	0.0022111664	5.8692969	-6.114235124	0.0028455248	0.002282697
##	356	355	0.0022111664	5.8721178	-6.114235124	0.0028242707	0.002273488
##	357	356	0.0022111664	5.8749307	-6.114235124	0.0028031754	0.002264341
##	358	357	0.0022111664	5.8777358	-6.114235124	0.0027822376	0.002255257
##	359	358	0.0022111664	5.8805330	-6.114235124	0.0027614562	0.002246235
##	360	359	0.0022111664	5.8833224	-6.114235124	0.0027408301	0.002237274
##	361	360	0.0022111664	5.8861040	-6.114235124	0.0027203580	0.002228373
##	362	361	0.0022111664	5.8888780	-6.114235124	0.0027000388	0.002219532
##	363	362	0.0022111664	5.8916442	-6.114235124	0.0026798714	0.002210751
##	364	363	0.0022111664	5.8944028	-6.114235124	0.0026598546	0.002202029
##	365	364	0.0022111664	5.8971539	-6.114235124	0.0026399874	0.002193364
##	366	365	0.0022111664	5.8998974	-6.114235124	0.0026202685	0.002184758
##	367	366	0.0022111664	5.9026333	-6.114235124	0.0026006969	0.002176208
##	368	367	0.0022111664	5.9053618	-6.114235124	0.0025812715	0.002167716
##	369	368	0.0022111664	5.9080829	-6.114235124	0.0025619912	0.002159279
##	370	369	0.0022111664	5.9107966	-6.114235124	0.0025428550	0.002150898
##	371	370	0.0022111664	5.9135030	-6.114235124	0.0025238616	0.002142572
##	372	371	0.0022111664	5.9162021	-6.114235124	0.0025050101	0.002134301
##	373	372	0.0022111664	5.9188939	-6.114235124	0.0024862994	0.002126084
##	374	373	0.0022111664	5.9215784	-6.114235124	0.0024677285	0.002117920
##	375	374	0.0022111664	5.9242558	-6.114235124	0.0024492963	0.002109809
##	376	375	0.0022111664	5.9269260	-6.114235124	0.0024310018	0.002101751
##	377	376	0.0022111664	5.9295891	-6.114235124	0.0024128439	0.002093745
##	378	377	0.0022111664	5.9322452	-6.114235124	0.0023948216	0.002085791
##	379	378	0.0022111664	5.9348942	-6.114235124	0.0023769340	0.002077888
##	380	379	0.0022111664	5.9375362	-6.114235124	0.0023591799	0.002070036
##	381	380	0.0022111664	5.9401713	-6.114235124	0.0023415585	0.002062234
##	382	381	0.0022111664	5.9427994	-6.114235124	0.0023240687	0.002054481
##	383	382	0.0022111664	5.9454206	-6.114235124	0.0023067095	0.002046778
##	384	383	0.0022111664	5.9480350	-6.114235124	0.0022894800	0.002039124
##	385	384	0.0022111664	5.9506426	-6.114235124	0.0022723792	0.002031518
##	386	385	0.0022111664	5.9532433	-6.114235124	0.0022554061	0.002023961

##	387	386	0.0022111664	5.9558374	-6.114235124	0.0022385598	0.002016451
##	388	387	0.0022111664	5.9584247	-6.114235124	0.0022218393	0.002008988
##	389	388	0.0022111664	5.9610053	-6.114235124	0.0022052437	0.002001572
##	390	389	0.0022111664	5.9635793	-6.114235124	0.0021887721	0.001994202
##	391	390	0.0022111664	5.9661467	-6.114235124	0.0021724235	0.001986879
##	392	391	0.0022111664	5.9687076	-6.114235124	0.0021561970	0.001979601
##	393	392	0.0022111664	5.9712618	-6.114235124	0.0021400917	0.001972368
##	394	393	0.0022111664	5.9738096	-6.114235124	0.0021241067	0.001965179
##	395	394	0.0022111664	5.9763509	-6.114235124	0.0021082411	0.001958035
##	396	395	0.0022111664	5.9788858	-6.114235124	0.0020924941	0.001950936
##	397	396	0.0022111664	5.9814142	-6.114235124	0.0020768646	0.001943879
##	398	397	0.0022111664	5.9839363	-6.114235124	0.0020613519	0.001936866
##	399	398	0.0022111664	5.9864520	-6.114235124	0.0020459550	0.001929896
##	400	399	0.0022111664	5.9889614	-6.114235124	0.0020306731	0.001922968
##	401	400	0.0022111664	5.9914645	-6.114235124	0.0020155054	0.001916083
##	402	401	0.0022111664	5.9939614	-6.114235124	0.0020004510	0.001909239
##	403	402	0.0022111664	5.9964521	-6.114235124	0.0019855090	0.001902436
##	404	403	0.0022111664	5.9989366	-6.114235124	0.0019706787	0.001895675
##	405	404	0.0022111664	6.0014149	-6.114235124	0.0019559591	0.001888954
##	406	405	0.0022111664	6.0038871	-6.114235124	0.0019413494	0.001882274
##	407	406	0.0022111664	6.0063532	-6.114235124	0.0019268489	0.001875633
##	408	407	0.0022111664	6.0088132	-6.114235124	0.0019124567	0.001869033
##	409	408	0.0022111664	6.0112672	-6.114235124	0.0018981720	0.001862471
##	410	409	0.0022111664	6.0137152	-6.114235124	0.0018839939	0.001855949
##	411	410	0.0022111664	6.0161572	-6.114235124	0.0018699218	0.001849465
##	412	411	0.0022111664	6.0185932	-6.114235124	0.0018559548	0.001843020
##	413	412	0.0022111664	6.0210233	-6.114235124	0.0018420921	0.001836613
##	414	413	0.0022111664	6.0234476	-6.114235124	0.0018283330	0.001830243
##	415	414	0.0022111664	6.0258660	-6.114235124	0.0018146766	0.001823911
##	416	415	0.0022111664	6.0282785	-6.114235124	0.0018011222	0.001817616
##	417	416	0.0022111664	6.0306853	-6.114235124	0.0017876691	0.001811358
##	418	417	0.0022111664	6.0330862	-6.114235124	0.0017743165	0.001805136
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##	420	419	0.0022111664	6.0378709	-6.114235124	0.0017479097	0.001792801
##	421	420	0.0022111664	6.0402547	-6.114235124	0.0017348540	0.001786687
##	422	421	0.0022111664	6.0426328	-6.114235124	0.0017218958	0.001780608
##	423	422	0.0022111664	6.0450053	-6.114235124	0.0017090345	0.001774565
##	424	423	0.0022111664	6.0473722	-6.114235124	0.0016962692	0.001768556
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##	426	425	0.0022111664	6.0520892	-6.114235124	0.0016710239	0.001756641
##	427	426	0.0022111664	6.0544393	-6.114235124	0.0016585425	0.001750735
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##	429	428	0.0022111664	6.0591232	-6.114235124	0.0016338588	0.001739023
##	430	429	0.0022111664	6.0614569	-6.114235124	0.0016216550	0.001733216
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##	436	435	0.0022111664	6.0753460	-6.114235124	0.0015503228	0.001699059
##	437	436	0.0022111664	6.0776422	-6.114235124	0.0015387430	0.001693477
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##	443	442	0.0022111664	6.0913099	-6.114235124	0.0014710579	0.001660631
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##	446	445	0.0022111664	6.0980743	-6.114235124	0.0014383402	0.001644610
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##	452	451	0.0022111664	6.1114673	-6.114235124	0.0013750716	0.001613346
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##	455	454	0.0022111664	6.1180972	-6.114235124	0.0013444887	0.001598090
##	456	455	0.0022111664	6.1202974	-6.114235124	0.0013344463	0.001593059
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##	471	470	0.0022111664	6.1527327	-6.114235124	0.0011925053	0.001520705
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##	474	473	0.0016583748	6.1590954	-6.401917197	0.0011659829	0.001506902
##	475	474	0.0016583748	6.1612073	-6.401917197	0.0011572738	0.001502348
##	476	475	0.0016583748	6.1633148	-6.401917197	0.0011486297	0.001497818
##	477	476	0.0016583748	6.1654179	-6.401917197	0.0011400503	0.001493311
##	478	477	0.0016583748	6.1675165	-6.401917197	0.0011315349	0.001488826
##	479	478	0.0016583748	6.1696107	-6.401917197	0.0011230831	0.001484365
##	480	479	0.0016583748	6.1717006	-6.401917197	0.0011146945	0.001479926
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##	485	484	0.0016583748	6.1820849	-6.401917197	0.0010736818	0.001458065
##	486	485	0.0016583748	6.1841489	-6.401917197	0.0010656621	0.001453759
##	487	486	0.0016583748	6.1862086	-6.401917197	0.0010577024	0.001449474
##	488	487	0.0016583748	6.1882641	-6.401917197	0.0010498021	0.001445211
##	489	488	0.0016583748	6.1903154	-6.401917197	0.0010419608	0.001440969
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##	494	493	0.0016583748	6.2005092	-6.401917197	0.0010036242	0.001420071

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##	499	498	0.0016583748	6.2106001	-6.401917197	0.0009666981	0.001399684
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##	504	503	0.0016583748	6.2205902	-6.401917197	0.0009311306	0.001379788
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##	506	505	0.0016583748	6.2245584	-6.401917197	0.0009172728	0.001371963
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##	518	517	0.0016583748	6.2480429	-6.401917197	0.0008383510	0.001326559
##	519	518	0.0016583748	6.2499752	-6.401917197	0.0008320891	0.001322890
##	520	519	0.0016583748	6.2519039	-6.401917197	0.0008258739	0.001319239
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##	522	521	0.0016583748	6.2557500	-6.401917197	0.0008135826	0.001311987
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##	524	523	0.0016583748	6.2595815	-6.401917197	0.0008014742	0.001304803
##	525	524	0.0016583748	6.2614917	-6.401917197	0.0007954878	0.001301237
##	526	525	0.0016583748	6.2633983	-6.401917197	0.0007895460	0.001297686
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##	528	527	0.0016583748	6.2672005	-6.401917197	0.0007777954	0.001290634
##	529	528	0.0016583748	6.2690963	-6.401917197	0.0007719858	0.001287133
##	530	529	0.0016583748	6.2709884	-6.401917197	0.0007662196	0.001283647
##	531	530	0.0016583748	6.2728770	-6.401917197	0.0007604965	0.001280178
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##	534	533	0.0016583748	6.2785214	-6.401917197	0.0007435823	0.001269864
##	535	534	0.0016583748	6.2803958	-6.401917197	0.0007380282	0.001266458
##	536	535	0.0016583748	6.2822667	-6.401917197	0.0007325157	0.001263067
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##	539	538	0.0016583748	6.2878586	-6.401917197	0.0007162238	0.001252986
##	540	539	0.0016583748	6.2897156	-6.401917197	0.0007108742	0.001249656
##	541	540	0.0016583748	6.2915691	-6.401917197	0.0007055644	0.001246341
##	542	541	0.0016583748	6.2934193	-6.401917197	0.0007002943	0.001243041
##	543	542	0.0016583748	6.2952660	-6.401917197	0.0006950636	0.001239755
##	544	543	0.0016583748	6.2971093	-6.401917197	0.0006898720	0.001236485
##	545	544	0.0016583748	6.2989492	-6.401917197	0.0006847191	0.001233229
##	546	545	0.0016583748	6.3007858	-6.401917197	0.0006796048	0.001229987
##	547	546	0.0016583748	6.3026190	-6.401917197	0.0006745286	0.001226760
##	548	547	0.0016583748	6.3044488	-6.401917197	0.0006694903	0.001223547

```

## 549 548 0.0016583748 6.3062753 -6.401917197 0.0006644897 0.001220349
## 550 549 0.0016583748 6.3080984 -6.401917197 0.0006595264 0.001217165
## 551 550 0.0016583748 6.3099183 -6.401917197 0.0006546002 0.001213995
## 552 551 0.0016583748 6.3117348 -6.401917197 0.0006497108 0.001210838
## 553 552 0.0016583748 6.3135480 -6.401917197 0.0006448579 0.001207696
## 554 553 0.0011055832 6.3153580 -6.807382305 0.0006400413 0.001204568
## 555 554 0.0005527916 6.3171647 -7.500529485 0.0006352606 0.001201453
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## 557 556 0.0005527916 6.3207683 -7.500529485 0.0006258062 0.001195264
## 558 557 0.0005527916 6.3225652 -7.500529485 0.0006211318 0.001192190
## 559 558 0.0005527916 6.3243590 -7.500529485 0.0006164924 0.001189130
## 560 559 0.0005527916 6.3261495 -7.500529485 0.0006118876 0.001186082
## 561 560 0.0005527916 6.3279368 -7.500529485 0.0006073173 0.001183048
## 562 561 0.0005527916 6.3297209 -7.500529485 0.0006027810 0.001180027
## 563 562 0.0005527916 6.3315018 -7.500529485 0.0005982787 0.001177020
## 564 563 0.0005527916 6.3332796 -7.500529485 0.0005938099 0.001174025
## 565 564 0.0005527916 6.3350543 -7.500529485 0.0005893746 0.001171043
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## 567 566 0.0000000000 6.3385941 -Inf NA NA
##      Power
## 1      NA
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## 3  0.67468244
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## 5  0.40827154
## 6  0.34731248
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## 8  0.27216005
## 9  0.24705793
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## 23 0.11869252
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## 33 0.09046867
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```

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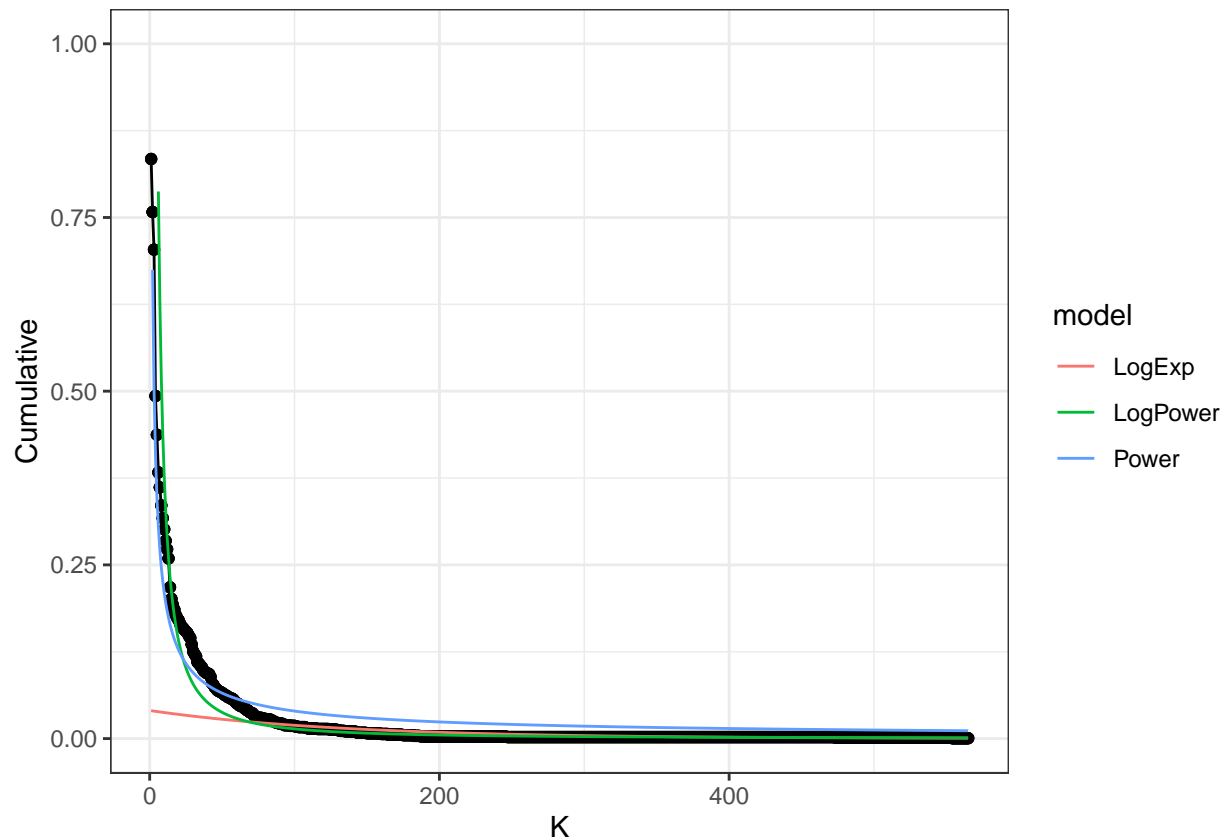
```

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## 522 0.01197879
## 523 0.01196215
## 524 0.01194557
## 525 0.01192905
## 526 0.01191258
## 527 0.01189616
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## 549 0.01154812
## 550 0.01153287
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## 558 0.01141260
## 559 0.01139777
## 560 0.01138299
## 561 0.01136826
## 562 0.01135357
## 563 0.01133892
## 564 0.01132433
## 565 0.01130977
## 566 0.01129526
## 567      NA
##
## $models
## # A tibble: 3 x 6
##   logLik    AIC    BIC model Normal.Resid family
##   <dbl> <dbl> <dbl> <chr>   <chr>      <chr>
## 1  1269. -2532. -2519. Power    No        PowerLaw
## 2   -238.   481.   494. LogPower No        PowerLaw

```

```
## 3 -658. 1322. 1335. LogExp No Exponential
##
## $graph
```

```
## Warning: Removed 6 rows containing missing values or values outside the scale range
## ('geom_line()').
```



```
##
## $params
## # A tibble: 6 x 6
##   term      estimate std.error statistic    p.value model
##   <chr>      <dbl>    <dbl>    <dbl>    <dbl> <chr>
## 1 c          2.33     0.0863     27.0 1.81e-103 LogPower
## 2 Beta      -1.43     0.0159    -90.2 0          LogPower
## 3 Beta      -0.725    0.00892   -81.3 3.70e-313 Power
## 4 c          1.11     0.0209     53.4 1.82e-222 Power
## 5 c          -3.21     0.0654    -49.0 2.67e-205 LogExp
## 6 Lambda -0.00750  0.000200   -37.4 7.77e-155 LogExp
```

```
# without #
nopsites_adj<- as.network(as_adjacency_matrix(igraph_nopsites), matrix.type = "adjacency")
NetworkExtinction::DegreeDistribution(nopsites_adj)
```

```
## Could not fit Exponential model: number of iterations exceeded maximum of 50
## Joining with 'by = join_by(K, Cumulative, LogK, LogCum)'Joining with 'by = join_by(K, Cumulative, LogK, LogCum)'
```

```
## $DDvalues
##      K      Cumulative      LogK      LogCum      LogExp      LogPower
## 1      0 0.9931600547      -Inf -0.006863445      NA      NA
## 2      1 0.9206566347 0.0000000 -0.082668130 0.0464971007 11.073830532
## 3      2 0.8830369357 0.6931472 -0.124388249 0.0461558895 4.159830316
## 4      3 0.8303693570 1.0986123 -0.185884669 0.0458171823 2.346046093
## 5      4 0.5800273598 1.3862944 -0.544680005 0.0454809606 1.562619927
## 6      5 0.5157318741 1.6094379 -0.662168272 0.0451472062 1.140150985
## 7      6 0.4541723666 1.7917595 -0.789278491 0.0448159010 0.881280749
## 8      7 0.4309165527 1.9459101 -0.841840821 0.0444870270 0.708839770
## 9      8 0.4056087551 2.0794415 -0.902366241 0.0441605665 0.586990538
## 10     9 0.3844049248 2.1972246 -0.956058790 0.0438365015 0.497021537
## 11    10 0.3618331053 2.3025851 -1.016572208 0.0435148147 0.428292145
## 12    11 0.3426812585 2.3978953 -1.070954539 0.0431954886 0.374343719
## 13    12 0.3283173735 2.4849066 -1.113774536 0.0428785057 0.331048806
## 14    13 0.3084815321 2.5649494 -1.176093301 0.0425638490 0.295657257
## 15    14 0.2558139535 2.6390573 -1.363304843 0.0422515014 0.266272195
## 16    15 0.2346101231 2.7080502 -1.449830193 0.0419414458 0.241546659
## 17    16 0.2250341997 2.7725887 -1.491502890 0.0416336655 0.220500127
## 18    17 0.2181942544 2.8332133 -1.522369538 0.0413281439 0.202403350
## 19    18 0.2065663475 2.8903718 -1.577133623 0.0410248642 0.186703711
## 20    19 0.1997264022 2.9444390 -1.610806838 0.0407238101 0.172975481
## 21    20 0.1949384405 2.9957323 -1.635071460 0.0404249653 0.160885851
## 22    21 0.1901504788 3.0445224 -1.659939527 0.0401283135 0.150171232
## 23    22 0.1860465116 3.0910425 -1.681758574 0.0398338386 0.140620388
## 24    23 0.1819425445 3.1354942 -1.704064332 0.0395415246 0.132062236
## 25    24 0.1798905609 3.1780538 -1.715406608 0.0392513558 0.124356866
## 26    25 0.1744186047 3.2188758 -1.746297095 0.0389633163 0.117388853
## 27    26 0.1730506156 3.2580965 -1.754171152 0.0386773906 0.111062203
## 28    27 0.1730506156 3.2958369 -1.754171152 0.0383935630 0.105296485
## 29    28 0.1703146375 3.3322045 -1.770107744 0.0381118183 0.100023849
## 30    29 0.1600547196 3.3672958 -1.832239525 0.0378321411 0.095186691
## 31    30 0.1484268126 3.4011974 -1.907663287 0.0375545163 0.090735822
## 32    31 0.1422708618 3.4339872 -1.950022561 0.0372789288 0.086629007
## 33    32 0.1347469220 3.4657359 -2.004356912 0.0370053636 0.082829795
## 34    33 0.1299589603 3.4965076 -2.040536568 0.0367338060 0.079306579
## 35    34 0.1279069767 3.5263605 -2.056452023 0.0364642411 0.076031829
## 36    35 0.1258549932 3.5553481 -2.072624883 0.0361966544 0.072981464
## 37    36 0.1231190150 3.5835189 -2.094603789 0.0359310313 0.070134337
## 38    37 0.1176470588 3.6109179 -2.140066163 0.0356673575 0.067471809
## 39    38 0.1142270862 3.6375862 -2.169566828 0.0354056186 0.064977394
## 40    39 0.1121751026 3.6635616 -2.187694212 0.0351458004 0.062636461
## 41    40 0.1108071135 3.6888795 -2.199964305 0.0348878888 0.060435984
## 42    41 0.1101231190 3.7135721 -2.206156275 0.0346318699 0.058364331
## 43    42 0.1060191518 3.7376696 -2.244135523 0.0343777297 0.056411089
## 44    43 0.0943912449 3.7612001 -2.360306955 0.0341254545 0.054566905
## 45    44 0.0916552668 3.7841896 -2.389720840 0.0338750306 0.052823362
## 46    45 0.0861833105 3.8066625 -2.451278733 0.0336264444 0.051172861
## 47    46 0.0834473324 3.8286414 -2.483539596 0.0333796824 0.049608534
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## 55	54	0.0683994528	3.9889840	-2.682390454	0.0314696718	0.039554110
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## 57	56	0.0670314637	4.0253517	-2.702593162	0.0310094966	0.037573470
## 58	57	0.0670314637	4.0430513	-2.702593162	0.0307819387	0.036645716
## 59	58	0.0663474692	4.0604430	-2.712849662	0.0305560506	0.035756415
## 60	59	0.0629274966	4.0775374	-2.765772063	0.0303318201	0.034903350
## 61	60	0.0601915185	4.0943446	-2.810223826	0.0301092351	0.034084468
## 62	61	0.0595075239	4.1108739	-2.821652522	0.0298882836	0.033297862
## 63	62	0.0567715458	4.1271344	-2.868720033	0.0296689534	0.032541763
## 64	63	0.0560875513	4.1431347	-2.880841393	0.0294512328	0.031814523
## 65	64	0.0540355677	4.1588831	-2.918112788	0.0292351099	0.031114608
## 66	65	0.0499316005	4.1743873	-2.997101199	0.0290205729	0.030440588
## 67	66	0.0492476060	4.1896547	-3.010894521	0.0288076103	0.029791129
## 68	67	0.0471956224	4.2046926	-3.053454136	0.0285962105	0.029164983
## 69	68	0.0458276334	4.2195077	-3.082868021	0.0283863620	0.028560985
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##	244	243	0.0034199726	5.4930614	-5.678122728	0.0078221976	0.004725973
##	245	244	0.0034199726	5.4971682	-5.678122728	0.0077647957	0.004698636
##	246	245	0.0034199726	5.5012582	-5.678122728	0.0077078151	0.004671569
##	247	246	0.0027359781	5.5053315	-5.901266279	0.0076512526	0.004644767
##	248	247	0.0027359781	5.5093883	-5.901266279	0.0075951051	0.004618226
##	249	248	0.0027359781	5.5134287	-5.901266279	0.0075393697	0.004591944
##	250	249	0.0027359781	5.5174529	-5.901266279	0.0074840433	0.004565916
##	251	250	0.0027359781	5.5214609	-5.901266279	0.0074291229	0.004540138
##	252	251	0.0027359781	5.5254529	-5.901266279	0.0073746056	0.004514609
##	253	252	0.0027359781	5.5294291	-5.901266279	0.0073204882	0.004489323
##	254	253	0.0027359781	5.5333895	-5.901266279	0.0072667681	0.004464279
##	255	254	0.0027359781	5.5373343	-5.901266279	0.0072134421	0.004439472
##	256	255	0.0027359781	5.5412635	-5.901266279	0.0071605075	0.004414900
##	257	256	0.0027359781	5.5451774	-5.901266279	0.0071079613	0.004390559
##	258	257	0.0027359781	5.5490761	-5.901266279	0.0070558007	0.004366446
##	259	258	0.0027359781	5.5529596	-5.901266279	0.0070040229	0.004342559
##	260	259	0.0027359781	5.5568281	-5.901266279	0.0069526251	0.004318894
##	261	260	0.0027359781	5.5606816	-5.901266279	0.0069016044	0.004295449
##	262	261	0.0027359781	5.5645204	-5.901266279	0.0068509581	0.004272220
##	263	262	0.0027359781	5.5683445	-5.901266279	0.0068006835	0.004249204
##	264	263	0.0027359781	5.5721540	-5.901266279	0.0067507778	0.004226400
##	265	264	0.0027359781	5.5759491	-5.901266279	0.0067012384	0.004203804
##	266	265	0.0027359781	5.5797298	-5.901266279	0.0066520625	0.004181413
##	267	266	0.0027359781	5.5834963	-5.901266279	0.0066032474	0.004159226
##	268	267	0.0027359781	5.5872487	-5.901266279	0.0065547906	0.004137238

##	269	268	0.0027359781	5.5909870	-5.901266279	0.0065066894	0.004115449
##	270	269	0.0027359781	5.5947114	-5.901266279	0.0064589411	0.004093855
##	271	270	0.0027359781	5.5984220	-5.901266279	0.0064115433	0.004072453
##	272	271	0.0027359781	5.6021188	-5.901266279	0.0063644932	0.004051242
##	273	272	0.0027359781	5.6058021	-5.901266279	0.0063177885	0.004030219
##	274	273	0.0027359781	5.6094718	-5.901266279	0.0062714264	0.004009382
##	275	274	0.0027359781	5.6131281	-5.901266279	0.0062254046	0.003988728
##	276	275	0.0027359781	5.6167711	-5.901266279	0.0061797206	0.003968255
##	277	276	0.0027359781	5.6204009	-5.901266279	0.0061343717	0.003947961
##	278	277	0.0027359781	5.6240175	-5.901266279	0.0060893557	0.003927843
##	279	278	0.0027359781	5.6276211	-5.901266279	0.0060446699	0.003907900
##	280	279	0.0027359781	5.6312118	-5.901266279	0.0060003121	0.003888129
##	281	280	0.0027359781	5.6347896	-5.901266279	0.0059562799	0.003868528
##	282	281	0.0027359781	5.6383547	-5.901266279	0.0059125707	0.003849096
##	283	282	0.0027359781	5.6419071	-5.901266279	0.0058691823	0.003829830
##	284	283	0.0027359781	5.6454469	-5.901266279	0.0058261123	0.003810728
##	285	284	0.0027359781	5.6489742	-5.901266279	0.0057833583	0.003791788
##	286	285	0.0027359781	5.6524892	-5.901266279	0.0057409181	0.003773008
##	287	286	0.0027359781	5.6559918	-5.901266279	0.0056987894	0.003754386
##	288	287	0.0027359781	5.6594822	-5.901266279	0.0056569698	0.003735921
##	289	288	0.0027359781	5.6629605	-5.901266279	0.0056154570	0.003717611
##	290	289	0.0027359781	5.6664267	-5.901266279	0.0055742489	0.003699453
##	291	290	0.0027359781	5.6698809	-5.901266279	0.0055333433	0.003681446
##	292	291	0.0027359781	5.6733233	-5.901266279	0.0054927377	0.003663589
##	293	292	0.0027359781	5.6767538	-5.901266279	0.0054524302	0.003645878
##	294	293	0.0027359781	5.6801726	-5.901266279	0.0054124185	0.003628314
##	295	294	0.0027359781	5.6835798	-5.901266279	0.0053727003	0.003610894
##	296	295	0.0027359781	5.6869754	-5.901266279	0.0053332737	0.003593616
##	297	296	0.0027359781	5.6903595	-5.901266279	0.0052941363	0.003576478
##	298	297	0.0027359781	5.6937321	-5.901266279	0.0052552862	0.003559480
##	299	298	0.0027359781	5.6970935	-5.901266279	0.0052167212	0.003542619
##	300	299	0.0027359781	5.7004436	-5.901266279	0.0051784391	0.003525895
##	301	300	0.0027359781	5.7037825	-5.901266279	0.0051404380	0.003509304
##	302	301	0.0027359781	5.7071103	-5.901266279	0.0051027158	0.003492847
##	303	302	0.0027359781	5.7104270	-5.901266279	0.0050652704	0.003476521
##	304	303	0.0027359781	5.7137328	-5.901266279	0.0050280997	0.003460324
##	305	304	0.0027359781	5.7170277	-5.901266279	0.0049912019	0.003444257
##	306	305	0.0027359781	5.7203118	-5.901266279	0.0049545748	0.003428316
##	307	306	0.0027359781	5.7235851	-5.901266279	0.0049182165	0.003412501
##	308	307	0.0027359781	5.7268477	-5.901266279	0.0048821250	0.003396810
##	309	308	0.0027359781	5.7300998	-5.901266279	0.0048462983	0.003381242
##	310	309	0.0027359781	5.7333413	-5.901266279	0.0048107346	0.003365795
##	311	310	0.0027359781	5.7365723	-5.901266279	0.0047754318	0.003350469
##	312	311	0.0027359781	5.7397929	-5.901266279	0.0047403881	0.003335261
##	313	312	0.0027359781	5.7430032	-5.901266279	0.0047056015	0.003320171
##	314	313	0.0027359781	5.7462032	-5.901266279	0.0046710703	0.003305197
##	315	314	0.0027359781	5.7493930	-5.901266279	0.0046367924	0.003290338
##	316	315	0.0027359781	5.7525726	-5.901266279	0.0046027661	0.003275593
##	317	316	0.0027359781	5.7557422	-5.901266279	0.0045689895	0.003260960
##	318	317	0.0027359781	5.7589018	-5.901266279	0.0045354607	0.003246439
##	319	318	0.0027359781	5.7620514	-5.901266279	0.0045021780	0.003232027
##	320	319	0.0027359781	5.7651911	-5.901266279	0.0044691395	0.003217725
##	321	320	0.0027359781	5.7683210	-5.901266279	0.0044363435	0.003203530
##	322	321	0.0027359781	5.7714411	-5.901266279	0.0044037881	0.003189442

##	323	322	0.0027359781	5.7745515	-5.901266279	0.0043714716	0.003175460
##	324	323	0.0027359781	5.7776523	-5.901266279	0.0043393923	0.003161581
##	325	324	0.0027359781	5.7807435	-5.901266279	0.0043075484	0.003147807
##	326	325	0.0027359781	5.7838252	-5.901266279	0.0042759382	0.003134134
##	327	326	0.0027359781	5.7868974	-5.901266279	0.0042445600	0.003120562
##	328	327	0.0027359781	5.7899602	-5.901266279	0.0042134120	0.003107091
##	329	328	0.0027359781	5.7930136	-5.901266279	0.0041824926	0.003093718
##	330	329	0.0027359781	5.7960578	-5.901266279	0.0041518000	0.003080444
##	331	330	0.0027359781	5.7990927	-5.901266279	0.0041213327	0.003067266
##	332	331	0.0027359781	5.8021184	-5.901266279	0.0040910890	0.003054185
##	333	332	0.0027359781	5.8051350	-5.901266279	0.0040610673	0.003041198
##	334	333	0.0027359781	5.8081425	-5.901266279	0.0040312658	0.003028306
##	335	334	0.0027359781	5.8111410	-5.901266279	0.0040016830	0.003015506
##	336	335	0.0027359781	5.8141305	-5.901266279	0.0039723174	0.003002799
##	337	336	0.0027359781	5.8171112	-5.901266279	0.0039431672	0.002990183
##	338	337	0.0027359781	5.8200829	-5.901266279	0.0039142309	0.002977657
##	339	338	0.0027359781	5.8230459	-5.901266279	0.0038855070	0.002965220
##	340	339	0.0027359781	5.8260001	-5.901266279	0.0038569938	0.002952872
##	341	340	0.0027359781	5.8289456	-5.901266279	0.0038286899	0.002940612
##	342	341	0.0027359781	5.8318825	-5.901266279	0.0038005937	0.002928438
##	343	342	0.0027359781	5.8348107	-5.901266279	0.0037727037	0.002916350
##	344	343	0.0027359781	5.8377304	-5.901266279	0.0037450184	0.002904347
##	345	344	0.0027359781	5.8406417	-5.901266279	0.0037175362	0.002892428
##	346	345	0.0027359781	5.8435444	-5.901266279	0.0036902557	0.002880592
##	347	346	0.0027359781	5.8464388	-5.901266279	0.0036631753	0.002868839
##	348	347	0.0027359781	5.8493248	-5.901266279	0.0036362937	0.002857168
##	349	348	0.0027359781	5.8522025	-5.901266279	0.0036096094	0.002845577
##	350	349	0.0027359781	5.8550719	-5.901266279	0.0035831209	0.002834067
##	351	350	0.0027359781	5.8579332	-5.901266279	0.0035568268	0.002822636
##	352	351	0.0027359781	5.8607862	-5.901266279	0.0035307256	0.002811283
##	353	352	0.0027359781	5.8636312	-5.901266279	0.0035048160	0.002800008
##	354	353	0.0027359781	5.8664681	-5.901266279	0.0034790964	0.002788810
##	355	354	0.0027359781	5.8692969	-5.901266279	0.0034535657	0.002777688
##	356	355	0.0027359781	5.8721178	-5.901266279	0.0034282223	0.002766642
##	357	356	0.0027359781	5.8749307	-5.901266279	0.0034030648	0.002755671
##	358	357	0.0027359781	5.8777358	-5.901266279	0.0033780920	0.002744774
##	359	358	0.0027359781	5.8805330	-5.901266279	0.0033533025	0.002733950
##	360	359	0.0027359781	5.8833224	-5.901266279	0.0033286948	0.002723199
##	361	360	0.0027359781	5.8861040	-5.901266279	0.0033042677	0.002712520
##	362	361	0.0027359781	5.8888780	-5.901266279	0.0032800199	0.002701912
##	363	362	0.0027359781	5.8916442	-5.901266279	0.0032559501	0.002691375
##	364	363	0.0027359781	5.8944028	-5.901266279	0.0032320568	0.002680908
##	365	364	0.0027359781	5.8971539	-5.901266279	0.0032083389	0.002670510
##	366	365	0.0027359781	5.8998974	-5.901266279	0.0031847950	0.002660181
##	367	366	0.0027359781	5.9026333	-5.901266279	0.0031614240	0.002649920
##	368	367	0.0027359781	5.9053618	-5.901266279	0.0031382244	0.002639726
##	369	368	0.0027359781	5.9080829	-5.901266279	0.0031151950	0.002629600
##	370	369	0.0027359781	5.9107966	-5.901266279	0.0030923347	0.002619539
##	371	370	0.0027359781	5.9135030	-5.901266279	0.0030696421	0.002609544
##	372	371	0.0027359781	5.9162021	-5.901266279	0.0030471161	0.002599614
##	373	372	0.0027359781	5.9188939	-5.901266279	0.0030247553	0.002589748
##	374	373	0.0027359781	5.9215784	-5.901266279	0.0030025587	0.002579946
##	375	374	0.0027359781	5.9242558	-5.901266279	0.0029805249	0.002570207
##	376	375	0.0027359781	5.9269260	-5.901266279	0.0029586528	0.002560531

##	377	376	0.0027359781	5.9295891	-5.901266279	0.0029369412	0.002550917
##	378	377	0.0027359781	5.9322452	-5.901266279	0.0029153890	0.002541364
##	379	378	0.0027359781	5.9348942	-5.901266279	0.0028939949	0.002531872
##	380	379	0.0027359781	5.9375362	-5.901266279	0.0028727578	0.002522441
##	381	380	0.0027359781	5.9401713	-5.901266279	0.0028516765	0.002513070
##	382	381	0.0027359781	5.9427994	-5.901266279	0.0028307500	0.002503757
##	383	382	0.0027359781	5.9454206	-5.901266279	0.0028099770	0.002494504
##	384	383	0.0027359781	5.9480350	-5.901266279	0.0027893565	0.002485309
##	385	384	0.0027359781	5.9506426	-5.901266279	0.0027688872	0.002476172
##	386	385	0.0027359781	5.9532433	-5.901266279	0.0027485682	0.002467091
##	387	386	0.0027359781	5.9558374	-5.901266279	0.0027283983	0.002458068
##	388	387	0.0027359781	5.9584247	-5.901266279	0.0027083764	0.002449101
##	389	388	0.0027359781	5.9610053	-5.901266279	0.0026885015	0.002440189
##	390	389	0.0027359781	5.9635793	-5.901266279	0.0026687723	0.002431333
##	391	390	0.0027359781	5.9661467	-5.901266279	0.0026491880	0.002422532
##	392	391	0.0027359781	5.9687076	-5.901266279	0.0026297474	0.002413784
##	393	392	0.0027359781	5.9712618	-5.901266279	0.0026104494	0.002405091
##	394	393	0.0027359781	5.9738096	-5.901266279	0.0025912931	0.002396451
##	395	394	0.0027359781	5.9763509	-5.901266279	0.0025722773	0.002387864
##	396	395	0.0027359781	5.9788858	-5.901266279	0.0025534011	0.002379329
##	397	396	0.0027359781	5.9814142	-5.901266279	0.0025346634	0.002370846
##	398	397	0.0027359781	5.9839363	-5.901266279	0.0025160632	0.002362415
##	399	398	0.0027359781	5.9864520	-5.901266279	0.0024975995	0.002354035
##	400	399	0.0027359781	5.9889614	-5.901266279	0.0024792713	0.002345705
##	401	400	0.0027359781	5.9914645	-5.901266279	0.0024610775	0.002337426
##	402	401	0.0027359781	5.9939614	-5.901266279	0.0024430173	0.002329196
##	403	402	0.0027359781	5.9964521	-5.901266279	0.0024250897	0.002321016
##	404	403	0.0027359781	5.9989366	-5.901266279	0.0024072936	0.002312885
##	405	404	0.0027359781	6.0014149	-5.901266279	0.0023896280	0.002304802
##	406	405	0.0027359781	6.0038871	-5.901266279	0.0023720922	0.002296768
##	407	406	0.0027359781	6.0063532	-5.901266279	0.0023546850	0.002288781
##	408	407	0.0027359781	6.0088132	-5.901266279	0.0023374055	0.002280841
##	409	408	0.0027359781	6.0112672	-5.901266279	0.0023202528	0.002272948
##	410	409	0.0027359781	6.0137152	-5.901266279	0.0023032260	0.002265102
##	411	410	0.0027359781	6.0161572	-5.901266279	0.0022863242	0.002257302
##	412	411	0.0027359781	6.0185932	-5.901266279	0.0022695464	0.002249548
##	413	412	0.0027359781	6.0210233	-5.901266279	0.0022528917	0.002241839
##	414	413	0.0027359781	6.0234476	-5.901266279	0.0022363592	0.002234176
##	415	414	0.0027359781	6.0258660	-5.901266279	0.0022199481	0.002226557
##	416	415	0.0027359781	6.0282785	-5.901266279	0.0022036574	0.002218982
##	417	416	0.0027359781	6.0306853	-5.901266279	0.0021874862	0.002211451
##	418	417	0.0027359781	6.0330862	-5.901266279	0.0021714337	0.002203963
##	419	418	0.0027359781	6.0354814	-5.901266279	0.0021554990	0.002196519
##	420	419	0.0027359781	6.0378709	-5.901266279	0.0021396812	0.002189118
##	421	420	0.0027359781	6.0402547	-5.901266279	0.0021239796	0.002181759
##	422	421	0.0027359781	6.0426328	-5.901266279	0.0021083931	0.002174442
##	423	422	0.0027359781	6.0450053	-5.901266279	0.0020929210	0.002167167
##	424	423	0.0027359781	6.0473722	-5.901266279	0.0020775624	0.002159934
##	425	424	0.0027359781	6.0497335	-5.901266279	0.0020623166	0.002152741
##	426	425	0.0027359781	6.0520892	-5.901266279	0.0020471826	0.002145590
##	427	426	0.0027359781	6.0544393	-5.901266279	0.0020321597	0.002138479
##	428	427	0.0027359781	6.0567840	-5.901266279	0.0020172471	0.002131408
##	429	428	0.0027359781	6.0591232	-5.901266279	0.0020024438	0.002124377
##	430	429	0.0027359781	6.0614569	-5.901266279	0.0019877492	0.002117385

##	431	430	0.0027359781	6.0637852	-5.901266279	0.0019731625	0.002110433
##	432	431	0.0027359781	6.0661081	-5.901266279	0.0019586828	0.002103520
##	433	432	0.0027359781	6.0684256	-5.901266279	0.0019443093	0.002096645
##	434	433	0.0027359781	6.0707377	-5.901266279	0.0019300413	0.002089808
##	435	434	0.0027359781	6.0730445	-5.901266279	0.0019158780	0.002083010
##	436	435	0.0027359781	6.0753460	-5.901266279	0.0019018187	0.002076249
##	437	436	0.0027359781	6.0776422	-5.901266279	0.0018878625	0.002069525
##	438	437	0.0027359781	6.0799332	-5.901266279	0.0018740087	0.002062839
##	439	438	0.0027359781	6.0822189	-5.901266279	0.0018602566	0.002056189
##	440	439	0.0027359781	6.0844994	-5.901266279	0.0018466055	0.002049576
##	441	440	0.0027359781	6.0867747	-5.901266279	0.0018330544	0.002043000
##	442	441	0.0027359781	6.0890449	-5.901266279	0.0018196029	0.002036459
##	443	442	0.0027359781	6.0913099	-5.901266279	0.0018062500	0.002029954
##	444	443	0.0027359781	6.0935698	-5.901266279	0.0017929952	0.002023484
##	445	444	0.0027359781	6.0958246	-5.901266279	0.0017798376	0.002017049
##	446	445	0.0027359781	6.0980743	-5.901266279	0.0017667765	0.002010650
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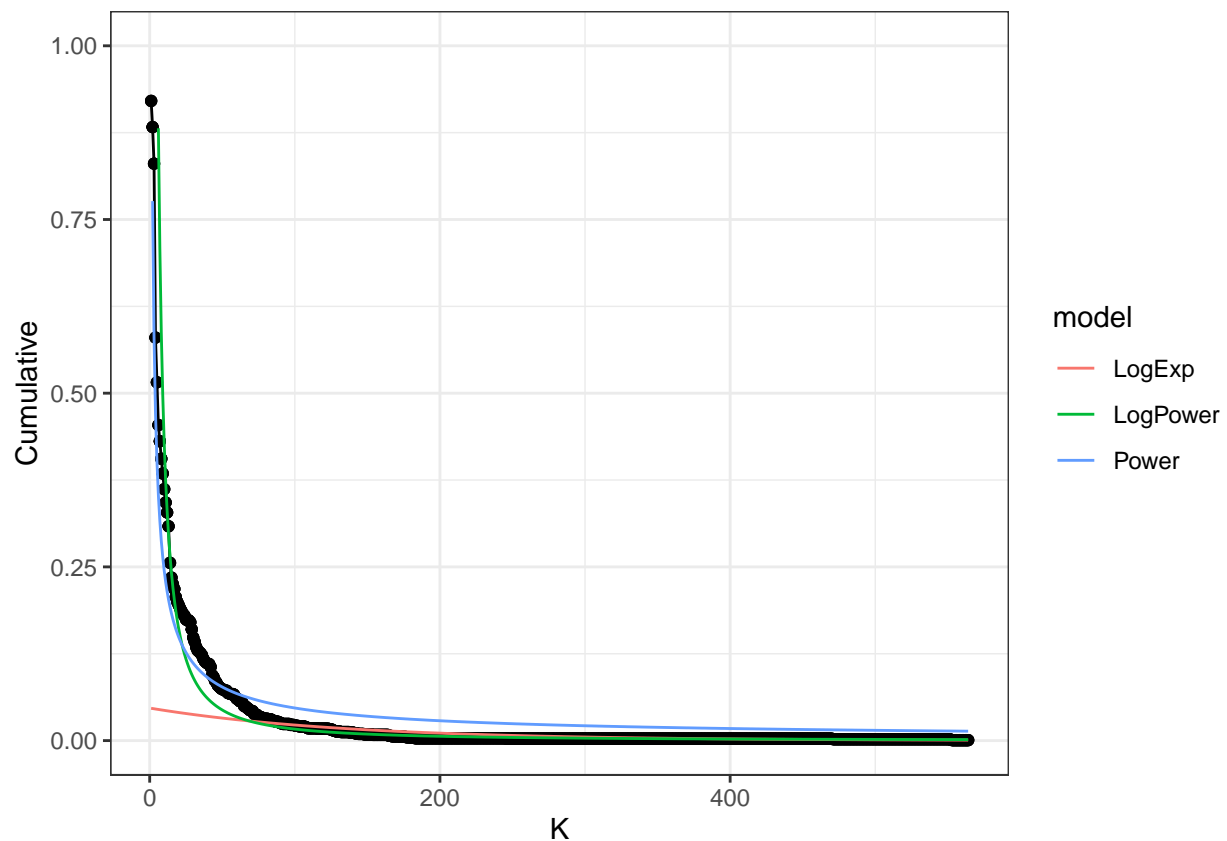
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411 0.01706420
412 0.01703441
413 0.01700475
414 0.01697521
415 0.01694579
416 0.01691649
417 0.01688732
418 0.01685826
419 0.01682933
420 0.01680051
421 0.01677181
422 0.01674323
423 0.01671476
424 0.01668641
425 0.01665817
426 0.01663005
427 0.01660204
428 0.01657415
429 0.01654637
430 0.01651869
431 0.01649113
432 0.01646368
433 0.01643634
434 0.01640910
435 0.01638198
436 0.01635496
437 0.01632804
438 0.01630124
439 0.01627454
440 0.01624794
441 0.01622145
442 0.01619505
443 0.01616877
444 0.01614258
445 0.01611650
446 0.01609051
447 0.01606463
448 0.01603884
449 0.01601316
450 0.01598757
451 0.01596208
452 0.01593669
453 0.01591139
454 0.01588619
455 0.01586109
456 0.01583608
457 0.01581116

458 0.01578634
459 0.01576161
460 0.01573698
461 0.01571243
462 0.01568798
463 0.01566362
464 0.01563935
465 0.01561516
466 0.01559107
467 0.01556707
468 0.01554315
469 0.01551933
470 0.01549558
471 0.01547193
472 0.01544836
473 0.01542488
474 0.01540149
475 0.01537817
476 0.01535495
477 0.01533180
478 0.01530874
479 0.01528577
480 0.01526287
481 0.01524006
482 0.01521733
483 0.01519468
484 0.01517211
485 0.01514962
486 0.01512721
487 0.01510488
488 0.01508263
489 0.01506045
490 0.01503836
491 0.01501634
492 0.01499440
493 0.01497253
494 0.01495074
495 0.01492903
496 0.01490739
497 0.01488583
498 0.01486434
499 0.01484293
500 0.01482159
501 0.01480032
502 0.01477913
503 0.01475801
504 0.01473696
505 0.01471598
506 0.01469507
507 0.01467424
508 0.01465347
509 0.01463278
510 0.01461216
511 0.01459160

512 0.01457111
513 0.01455070
514 0.01453035
515 0.01451007
516 0.01448985
517 0.01446971
518 0.01444963
519 0.01442962
520 0.01440967
521 0.01438979
522 0.01436998
523 0.01435023
524 0.01433054
525 0.01431092
526 0.01429136
527 0.01427187
528 0.01425244
529 0.01423308
530 0.01421378
531 0.01419454
532 0.01417536
533 0.01415624
534 0.01413719
535 0.01411820
536 0.01409926
537 0.01408039
538 0.01406158
539 0.01404283
540 0.01402414
541 0.01400551
542 0.01398694
543 0.01396842
544 0.01394997
545 0.01393157
546 0.01391323
547 0.01389495
548 0.01387673
549 0.01385856
550 0.01384045
551 0.01382240
552 0.01380440
553 0.01378646
554 0.01376857
555 0.01375074
556 0.01373297
557 0.01371525
558 0.01369758
559 0.01367997
560 0.01366242
561 0.01364491
562 0.01362747
563 0.01361007
564 0.01359273
565 0.01357544

```
## 566      NA
##
## $models
## # A tibble: 3 x 6
##   logLik    AIC    BIC model Normal.Resid family
##   <dbl> <dbl> <dbl> <chr>   <chr>      <chr>
## 1  1149. -2291. -2278. Power    No      PowerLaw
## 2   -239.   483.   496. LogPower No      PowerLaw
## 3   -658.  1322.  1335. LogExp  No      Exponential
##
## $graph

## Warning: Removed 6 rows containing missing values or values outside the scale range
## ('geom_line()').
```



```
##
## $params
## # A tibble: 6 x 6
##   term   estimate std.error statistic  p.value model
##   <chr>     <dbl>    <dbl>    <dbl>    <dbl> <chr>
## 1 c         2.40     0.0866     27.8 1.83e-107 LogPower
## 2 Beta     -1.41     0.0159    -88.6 0          LogPower
## 3 Beta     -0.717    0.00938   -76.4 3.69e-299 Power
## 4 c         1.28     0.0256     49.8 2.78e-208 Power
## 5 c        -3.06     0.0656    -46.7 2.08e-195 LogExp
## 6 Lambda  -0.00737  0.000201   -36.6 6.98e-151 LogExp
```

Ok, so for actually comparing webs, Dana compared the following:

-

nodes

-

links

- link density
- Connectance
- Adjusted connectance (Lafferty et al 2006)
- Longest chain
- Mean degree
- Sd degree
- Mean generality
- Sd generality
- Mean vulnerability
- Sd vulnerability

For parasite web

```
##### Parasite Web #####
# total potential links (m)
m <- vcount(igraph_psites)^2

# link density
link_dens.p <- edge_density(igraph_psites, loops = TRUE) # links/# nodes

# connectance # links/potential links
connectance <- vcount(igraph_psites)/m

# longest chain
longest.p <- diameter(igraph_psites)

# mean chain length:
mean_chain <- mean_distance(igraph_psites, directed = TRUE, details = TRUE)
average_chain_length_p <- mean_chain$res
## cannot find a way to extract any measure of variance

# histogram of chain lengths 1-8
dtable.p <- distance_table(igraph_psites, directed = TRUE)
```

```

# matrix of all distances between all nodes
dist.p <- distances(igraph_psites, algorithm = "dijkstra")

# mean degree
mean_deg.p <- mean(deg.p)
sd_deg.p <- sd(deg.p)

# mean generality
out.p <- igraph::degree(igraph_psites, mode = "out")
mean_gen.p <- mean(out.p)
sd_gen.p <- sd(out.p)

# mean vulnerability
inn <- igraph::degree(igraph_psites, mode = "in")
mean_vul.p <- mean(inn)
sd_vul.p <- sd(inn)

```

For free no parasites/living web

```

##### Parasite Web #####
# total potential links (m)
m.np <- vcount(igraph_nopsites)^2

# link density
link_dens.np <- edge_density(igraph_nopsites, loops = TRUE) # links/# nodes

# connectance # links/potential links
connectance.np <- vcount(igraph_nopsites)/m.np

# longest chain
longest.np <- diameter(igraph_nopsites)

# mean chain length:
mean_chain.np <- mean_distance(igraph_nopsites, directed = TRUE, details = TRUE)
average_chain_length.np <- mean_chain.np$res
## cannot find a way to extract any measure of variance

# histogram of chain lengths 1-8
dtable.np <- distance_table(igraph_nopsites, directed = TRUE)

# matrix of all distances between all nodes
dist.np <- distances(igraph_nopsites, algorithm = "dijkstra")

# mean degree
mean_deg.np <- mean(deg.np)
sd_deg.np <- sd(deg.np)

# mean generality
out.np <- igraph::degree(igraph_nopsites, mode = "out")
mean_gen.np <- mean(out.np)
sd_gen.np <- sd(out.np)

```

```
# mean vulnerability
in.np <- igraph::degree(igraph_nopsites, mode = "in")
mean_vul.np <- mean(in.np)
sd_vul.np <- sd(in.np)
```

Make a nice table comparing values

```
values <- c("Total Possible Links", "Link Density", "Connectance", "Longest Chain", "Mean Chain Length")
parasite <- c(m, link_dens.p, connectance, longest.p, average_chain_length.p, mean_deg.p, sd_deg.p, mean_deg.np, sd_deg.np)
free_living <- c(m.np, link_dens.np, connectance.np, longest.np, average_chain_length.np, mean_deg.np, sd_deg.np, mean_deg.np, sd_deg.np)

psite_comp_table <- tibble(values, parasite, free_living)
kable(psite_comp_table)
```

values	parasite	free_living
Total Possible Links	3.272481e+06	2.137444e+06
Link Density	4.142400e-03	5.947300e-03
Connectance	5.528000e-04	6.840000e-04
Longest Chain	8.000000e+00	8.000000e+00
Mean Chain Length	2.916777e+00	2.361180e+00
Mean Degree	1.498729e+01	1.738988e+01
SD Degree	3.438485e+01	3.704477e+01
Mean Generality	7.493643e+00	8.694938e+00
SD Generality	3.035261e+01	3.332176e+01
Mean Vulnerability	7.493643e+00	8.694938e+00
SD Vulnerability	1.469532e+01	1.567876e+01

attempts to use cheddar for chain length calculations failed because of web size

```
#options(cheddarMaxQueue=0)
```

```
# We remove cannibalistic links to avoid entering an infinite loop when calculating path lengths
```

```
#ca_riz_parasites1 <- RemoveCannibalisticLinks(ca_riz_parasites, title='no cannibals')
```

```
#ca_riz_parasites_ag <- LumpTrophicSpecies(ca_riz_parasites, include.isolated = FALSE, title = 'trophic')
```

```
#QuantitativeDescriptors(ca_riz_parasites_ag, weight = 'confidence')
```

```
#TrophicChainsStats(ca_riz_parasites_ag)
```