

STAT 33B Homework 2

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Sep 24, 2020

This homework is due **Sep 24, 2020** by 11:59pm PT.

Homeworks are graded for correctness.

As you work, write your answers in this notebook. Answer questions with complete sentences, and put code in code chunks. You can make as many new code chunks as you like.

Please do not delete the exercises already in this notebook, because it may interfere with our grading tools.

You need to submit your work in two places:

- Submit this Rmd file with your edits on bCourses.
- Knit and submit the generated PDF file on Gradescope.

Exercise 1

For this assignment, you'll use the Datasaurus Dozen data set, which is available on the bCourse (DatasaurusDozen.tsv).

Load the Datasaurus Dozen data set and assign it to a variable named `dsaur`.

YOUR ANSWER GOES HERE:

```
dsaur = read.table("DatasaurusDozen.tsv", header = TRUE)
dsaur
```

```
##      dataset      x      y
## 1      dino 55.38460 97.17950000
## 2      dino 51.53850 96.02560000
## 3      dino 46.15380 94.48720000
## 4      dino 42.82050 91.41030000
## 5      dino 40.76920 88.33330000
## 6      dino 38.71790 84.87180000
## 7      dino 35.64100 79.87180000
## 8      dino 33.07690 77.56410000
## 9      dino 28.97440 74.48720000
## 10     dino 26.15380 71.41030000
## 11     dino 23.07690 66.41030000
## 12     dino 22.30770 61.79490000
## 13     dino 22.30770 57.17950000
## 14     dino 23.33330 52.94870000
## 15     dino 25.89740 51.02560000
## 16     dino 29.48720 51.02560000
```

## 17	dino	32.82050	51.02560000
## 18	dino	35.38460	51.41030000
## 19	dino	40.25640	51.41030000
## 20	dino	44.10260	52.94870000
## 21	dino	46.66670	54.10260000
## 22	dino	50.00000	55.25640000
## 23	dino	53.07690	55.64100000
## 24	dino	56.66670	56.02560000
## 25	dino	59.23080	57.94870000
## 26	dino	61.28210	62.17950000
## 27	dino	61.53850	66.41030000
## 28	dino	61.79490	69.10260000
## 29	dino	57.43590	55.25640000
## 30	dino	54.87180	49.87180000
## 31	dino	52.56410	46.02560000
## 32	dino	48.20510	38.33330000
## 33	dino	49.48720	42.17950000
## 34	dino	51.02560	44.10260000
## 35	dino	45.38460	36.41030000
## 36	dino	42.82050	32.56410000
## 37	dino	38.71790	31.41030000
## 38	dino	35.12820	30.25640000
## 39	dino	32.56410	32.17950000
## 40	dino	30.00000	36.79490000
## 41	dino	33.58970	41.41030000
## 42	dino	36.66670	45.64100000
## 43	dino	38.20510	49.10260000
## 44	dino	29.74360	36.02560000
## 45	dino	29.74360	32.17950000
## 46	dino	30.00000	29.10260000
## 47	dino	32.05130	26.79490000
## 48	dino	35.89740	25.25640000
## 49	dino	41.02560	25.25640000
## 50	dino	44.10260	25.64100000
## 51	dino	47.17950	28.71800000
## 52	dino	49.48720	31.41030000
## 53	dino	51.53850	34.87180000
## 54	dino	53.58970	37.56410000
## 55	dino	55.12820	40.64100000
## 56	dino	56.66670	42.17950000
## 57	dino	59.23080	44.48720000
## 58	dino	62.30770	46.02560000
## 59	dino	64.87180	46.79490000
## 60	dino	67.94870	47.94870000
## 61	dino	70.51280	53.71800000
## 62	dino	71.53850	60.64100000
## 63	dino	71.53850	64.48720000
## 64	dino	69.48720	69.48720000
## 65	dino	46.92310	79.87180000
## 66	dino	48.20510	84.10260000
## 67	dino	50.00000	85.25640000
## 68	dino	53.07690	85.25640000
## 69	dino	55.38460	86.02560000
## 70	dino	56.66670	86.02560000

## 71	dino	56.15380	82.94870000
## 72	dino	53.84620	80.64100000
## 73	dino	51.28210	78.71800000
## 74	dino	50.00000	78.71800000
## 75	dino	47.94870	77.56410000
## 76	dino	29.74360	59.87180000
## 77	dino	29.74360	62.17950000
## 78	dino	31.28210	62.56410000
## 79	dino	57.94870	99.48720000
## 80	dino	61.79490	99.10260000
## 81	dino	64.87180	97.56410000
## 82	dino	68.46150	94.10260000
## 83	dino	70.76920	91.02560000
## 84	dino	72.05130	86.41030000
## 85	dino	73.84620	83.33330000
## 86	dino	75.12820	79.10260000
## 87	dino	76.66670	75.25640000
## 88	dino	77.69230	71.41030000
## 89	dino	79.74360	66.79490000
## 90	dino	81.79490	60.25640000
## 91	dino	83.33330	55.25640000
## 92	dino	85.12820	51.41030000
## 93	dino	86.41030	47.56410000
## 94	dino	87.94870	46.02560000
## 95	dino	89.48720	42.56410000
## 96	dino	93.33330	39.87180000
## 97	dino	95.38460	36.79490000
## 98	dino	98.20510	33.71800000
## 99	dino	56.66670	40.64100000
## 100	dino	59.23080	38.33330000
## 101	dino	60.76920	33.71800000
## 102	dino	63.07690	29.10260000
## 103	dino	64.10260	25.25640000
## 104	dino	64.35900	24.10260000
## 105	dino	74.35900	22.94870000
## 106	dino	71.28210	22.94870000
## 107	dino	67.94870	22.17950000
## 108	dino	65.89740	20.25640000
## 109	dino	63.07690	19.10260000
## 110	dino	61.28210	19.10260000
## 111	dino	58.71790	18.33330000
## 112	dino	55.12820	18.33330000
## 113	dino	52.30770	18.33330000
## 114	dino	49.74360	17.56410000
## 115	dino	47.43590	16.02560000
## 116	dino	44.87180	13.71800000
## 117	dino	48.71790	14.87180000
## 118	dino	51.28210	14.87180000
## 119	dino	54.10260	14.87180000
## 120	dino	56.15380	14.10260000
## 121	dino	52.05130	12.56410000
## 122	dino	48.71790	11.02560000
## 123	dino	47.17950	9.87180000
## 124	dino	46.15380	6.02560000

## 125	dino	50.51280	9.48720000
## 126	dino	53.84620	10.25640000
## 127	dino	57.43590	10.25640000
## 128	dino	60.00000	10.64100000
## 129	dino	64.10260	10.64100000
## 130	dino	66.92310	10.64100000
## 131	dino	71.28210	10.64100000
## 132	dino	74.35900	10.64100000
## 133	dino	78.20510	10.64100000
## 134	dino	67.94870	8.71800000
## 135	dino	68.46150	5.25640000
## 136	dino	68.20510	2.94870000
## 137	dino	37.69230	25.76920000
## 138	dino	39.48720	25.38460000
## 139	dino	91.28210	41.53850000
## 140	dino	50.00000	95.76920000
## 141	dino	47.94870	95.00000000
## 142	dino	44.10260	92.69230000
## 143	away	32.33111	61.41110125
## 144	away	53.42146	26.18688039
## 145	away	63.92020	30.83219392
## 146	away	70.28951	82.53364859
## 147	away	34.11883	45.73455132
## 148	away	67.67072	37.11094797
## 149	away	53.25913	97.47577110
## 150	away	63.51498	25.10007858
## 151	away	67.98054	80.95716522
## 152	away	67.37247	29.72040020
## 153	away	15.56075	80.06564029
## 154	away	71.79077	71.06546666
## 155	away	70.24255	24.10959755
## 156	away	64.93744	81.55420499
## 157	away	62.21352	21.47583900
## 158	away	67.26940	18.70896837
## 159	away	40.57020	79.37296348
## 160	away	74.74118	21.10163720
## 161	away	71.76832	20.01106184
## 162	away	76.16692	75.93617040
## 163	away	65.62366	15.58280335
## 164	away	50.85063	13.98760163
## 165	away	33.02407	24.46783039
## 166	away	39.70633	84.27528710
## 167	away	45.59648	9.76334885
## 168	away	42.96805	17.94545840
## 169	away	52.49441	16.05111420
## 170	away	46.08228	23.11045782
## 171	away	74.24771	20.31418781
## 172	away	64.56826	83.63963390
## 173	away	74.02169	76.12827451
## 174	away	62.39118	5.62307076
## 175	away	74.18904	68.13358322
## 176	away	28.23678	56.13959645
## 177	away	75.77194	69.82923003
## 178	away	75.85523	62.51704429

## 179	away	65.97086	72.74485600
## 180	away	21.77804	6.61662531
## 181	away	67.75980	72.42120153
## 182	away	78.61720	52.57525731
## 183	away	68.50771	15.45691897
## 184	away	74.88502	25.41660632
## 185	away	66.45490	19.83662865
## 186	away	77.31780	48.39834644
## 187	away	58.91246	75.66775622
## 188	away	57.61745	8.19480060
## 189	away	76.08823	59.67993002
## 190	away	57.46605	1.50441817
## 191	away	79.42838	45.21079429
## 192	away	76.35652	10.41824113
## 193	away	64.40508	78.58417608
## 194	away	40.63504	73.39475037
## 195	away	43.94986	75.95871567
## 196	away	30.99622	71.69440494
## 197	away	68.23077	80.87250166
## 198	away	72.04639	12.91800673
## 199	away	46.59277	84.97238278
## 200	away	49.25722	81.88140323
## 201	away	42.78176	12.99118843
## 202	away	65.47595	14.27458564
## 203	away	71.96508	17.71023594
## 204	away	32.14646	43.48170944
## 205	away	31.83850	71.81216539
## 206	away	31.00526	40.68250301
## 207	away	80.47089	49.50214835
## 208	away	71.96417	41.87428267
## 209	away	78.07942	93.13331677
## 210	away	41.67760	30.20126408
## 211	away	65.95360	31.14740608
## 212	away	62.93446	31.91639070
## 213	away	64.37380	28.86258341
## 214	away	72.50933	39.54013025
## 215	away	30.05229	96.61754235
## 216	away	28.00332	46.67219195
## 217	away	75.40123	88.63907662
## 218	away	38.98002	87.32216069
## 219	away	65.21991	84.68295493
## 220	away	73.05399	29.38080856
## 221	away	34.39836	59.54444690
## 222	away	43.49045	40.78254207
## 223	away	55.13874	30.72576036
## 224	away	43.68439	32.82300987
## 225	away	35.90361	91.11186308
## 226	away	45.37802	29.16921665
## 227	away	39.77748	43.75581895
## 228	away	38.66446	33.31723848
## 229	away	39.04404	84.67601083
## 230	away	91.63996	79.40660306
## 231	away	47.48813	85.38993338
## 232	away	44.59021	22.03401164

## 233	away	39.08961	70.46619408
## 234	away	42.22938	19.91406841
## 235	away	37.00039	60.26427925
## 236	away	39.05209	70.65250285
## 237	away	37.48841	60.81440485
## 238	away	69.35956	65.52135460
## 239	away	43.54278	62.46031128
## 240	away	39.81123	65.33483281
## 241	away	70.06893	7.59346561
## 242	away	70.04054	77.14380660
## 243	away	39.50579	74.85162722
## 244	away	62.51689	66.48473224
## 245	away	72.13993	0.01511933
## 246	away	45.25158	70.00342132
## 247	away	42.06330	2.33519661
## 248	away	36.35570	6.00584865
## 249	away	30.39183	42.75961287
## 250	away	36.44900	50.54626907
## 251	away	40.46758	60.02751209
## 252	away	81.72462	6.03754485
## 253	away	48.82320	76.63533058
## 254	away	35.62056	57.28601558
## 255	away	50.58396	71.80661610
## 256	away	61.85647	71.79274316
## 257	away	39.32376	59.30081967
## 258	away	42.18568	66.03489782
## 259	away	30.84692	37.34164010
## 260	away	29.34620	42.14874183
## 261	away	82.11056	1.21055166
## 262	away	38.30201	60.01778579
## 263	away	56.58415	70.51251481
## 264	away	33.33937	0.50910674
## 265	away	78.77424	35.48410121
## 266	away	27.92264	25.98687818
## 267	away	71.69787	10.86814451
## 268	away	74.13833	49.17391898
## 269	away	32.57902	1.80811560
## 270	away	59.83219	69.15250814
## 271	away	35.03063	12.53664934
## 272	away	74.30012	42.47709459
## 273	away	63.25020	65.95248620
## 274	away	34.17307	25.69367431
## 275	away	40.91383	38.55901955
## 276	away	62.83329	62.51089423
## 277	away	42.47679	56.73128997
## 278	away	52.03346	64.56666203
## 279	away	48.90704	74.28774883
## 280	away	59.85184	72.95839097
## 281	away	48.96046	72.62952573
## 282	away	46.84486	36.79171369
## 283	away	39.96302	42.94491485
## 284	away	66.70494	32.01509543
## 285	h_lines	53.36657	90.20803001
## 286	h_lines	52.80198	90.08806451

```

## 287      h_lines 47.05413 90.45893603
## 288      h_lines 42.44843 89.50770012
## 289      h_lines 42.70404 90.44262886
## 290      h_lines 32.37894 90.14414263
## 291      h_lines 32.53070 70.15739651
## 292      h_lines 33.36526 70.45933544
## 293      h_lines 32.65610 70.05107050
## 294      h_lines 22.95509 70.42689515
## 295      h_lines 27.14984 70.21080584
## 296      h_lines 26.16691 70.50031512
## 297      h_lines 26.33146 50.49455653
## 298      h_lines 22.00371 50.49944012
## 299      h_lines 23.28475 50.47435283
## 300      h_lines 27.63404 50.50366686
## 301      h_lines 32.03711 50.50006612
## 302      h_lines 29.33651 50.46189397
## 303      h_lines 40.81695 50.48776020
## 304      h_lines 42.73908 50.48315599
## 305      h_lines 51.86789 50.49327326
## 306      h_lines 43.37100 50.50083732
## 307      h_lines 53.04280 50.48750387
## 308      h_lines 56.61891 50.50337402
## 309      h_lines 70.56829 50.49623612
## 310      h_lines 67.87089 70.06802613
## 311      h_lines 58.82155 70.45578175
## 312      h_lines 60.18693 70.48355125
## 313      h_lines 59.43552 50.42063261
## 314      h_lines 49.58584 50.43498138
## 315      h_lines 41.77974 50.47064228
## 316      h_lines 46.12769 30.44941078
## 317      h_lines 38.03378 50.49089952
## 318      h_lines 44.54684 50.41591338
## 319      h_lines 46.23812 30.49561294
## 320      h_lines 49.73975 30.47272489
## 321      h_lines 39.11025 30.47869518
## 322      h_lines 39.14284 30.79285594
## 323      h_lines 34.62547 30.49974103
## 324      h_lines 34.75421 30.49586500
## 325      h_lines 36.75370 50.52930430
## 326      h_lines 37.01935 50.49266670
## 327      h_lines 41.41712 50.46977342
## 328      h_lines 22.81711 30.43604034
## 329      h_lines 34.80070 30.49793139
## 330      h_lines 27.89189 30.48497026
## 331      h_lines 32.87064 30.50234175
## 332      h_lines 37.79405 30.49263834
## 333      h_lines 35.66732 30.52203505
## 334      h_lines 48.44230 30.50172278
## 335      h_lines 58.66937 30.50683789
## 336      h_lines 47.91696 30.48672575
## 337      h_lines 51.89417 30.49475568
## 338      h_lines 51.74909 30.47299334
## 339      h_lines 58.24655 50.44287449
## 340      h_lines 57.31070 50.48251329

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## 341      h_lines 67.96805 50.45215891
## 342      h_lines 65.94932 50.49424079
## 343      h_lines 55.74709 50.47897480
## 344      h_lines 68.40301 50.49862723
## 345      h_lines 76.69647 50.49383056
## 346      h_lines 67.21484 70.26002844
## 347      h_lines 72.30201 70.22043738
## 348      h_lines 66.76326 70.47386171
## 349      h_lines 51.68030 89.99702755
## 350      h_lines 53.09656 89.54024371
## 351      h_lines 42.24229 89.70857859
## 352      h_lines 56.23388 89.63530816
## 353      h_lines 54.68099 89.96459946
## 354      h_lines 57.90269 89.61840173
## 355      h_lines 51.82026 89.83413040
## 356      h_lines 56.82840 89.58366473
## 357      h_lines 58.27228 69.90027296
## 358      h_lines 51.82813 70.35264921
## 359      h_lines 44.84998 70.39520297
## 360      h_lines 24.27038 50.48556769
## 361      h_lines 34.74247 70.33993489
## 362      h_lines 37.79931 70.46953588
## 363      h_lines 49.78694 89.65804699
## 364      h_lines 59.75150 89.73193252
## 365      h_lines 64.77480 90.13231674
## 366      h_lines 70.84445 89.92420902
## 367      h_lines 70.60595 90.04206196
## 368      h_lines 78.64249 89.55120323
## 369      h_lines 70.81069 89.59265401
## 370      h_lines 66.76995 70.42337521
## 371      h_lines 73.33637 70.31692717
## 372      h_lines 73.10515 70.30051188
## 373      h_lines 74.67825 70.44531419
## 374      h_lines 80.24025 70.35430896
## 375      h_lines 70.94685 50.47270179
## 376      h_lines 88.66266 50.45532602
## 377      h_lines 84.40595 50.49486589
## 378      h_lines 75.98710 50.49196696
## 379      h_lines 91.11209 50.48938939
## 380      h_lines 98.28812 30.60391937
## 381      h_lines 95.06527 30.50040287
## 382      h_lines 95.24923 30.45945421
## 383      h_lines 49.65613 50.43131987
## 384      h_lines 63.01860 30.49258193
## 385      h_lines 70.53820 30.48355825
## 386      h_lines 70.08687 30.51004482
## 387      h_lines 62.68569 30.54642456
## 388      h_lines 69.23942 30.50600524
## 389      h_lines 80.40023 30.48500637
## 390      h_lines 74.64788 30.67386286
## 391      h_lines 65.99527 30.47502419
## 392      h_lines 67.08856 30.49452395
## 393      h_lines 59.85258 10.54318778
## 394      h_lines 53.74899 10.52257453

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## 395      h_lines 58.23910 10.49489903
## 396      h_lines 54.81030 10.72492928
## 397      h_lines 52.97671 10.85949028
## 398      h_lines 52.20389 10.49563692
## 399      h_lines 50.74516 10.52490557
## 400      h_lines 42.71319 10.48754724
## 401      h_lines 45.31723 10.49587339
## 402      h_lines 53.11692 10.50686060
## 403      h_lines 57.04980 10.50813694
## 404      h_lines 54.85463 10.46391519
## 405      h_lines 54.92484 10.49833194
## 406      h_lines 63.30955 10.48881424
## 407      h_lines 49.74950 10.48580291
## 408      h_lines 41.16931 10.49730024
## 409      h_lines 46.68834 10.50753214
## 410      h_lines 52.41892 10.49590636
## 411      h_lines 50.87849 10.50308987
## 412      h_lines 57.05331 10.51406924
## 413      h_lines 70.78645 10.51369504
## 414      h_lines 56.77215 10.50327235
## 415      h_lines 75.47722 10.51856804
## 416      h_lines 76.76591 10.49699906
## 417      h_lines 77.62105 10.49587423
## 418      h_lines 65.41449 10.68184013
## 419      h_lines 69.96478 10.50723293
## 420      h_lines 64.96974 10.48215951
## 421      h_lines 38.05024 30.40794603
## 422      h_lines 42.22412 30.49803716
## 423      h_lines 87.69846 50.48993653
## 424      h_lines 52.36033 89.70431701
## 425      h_lines 51.40679 89.71213855
## 426      h_lines 43.58847 89.74553655
## 427      v_lines 50.48151 93.22270137
## 428      v_lines 50.28241 97.60998357
## 429      v_lines 50.18670 99.69468014
## 430      v_lines 50.32691 90.02205349
## 431      v_lines 50.45621 89.98741013
## 432      v_lines 30.46485 82.08923208
## 433      v_lines 30.50160 82.30712635
## 434      v_lines 30.48957 77.72988014
## 435      v_lines 30.45025 79.83489440
## 436      v_lines 30.51839 68.25258294
## 437      v_lines 30.51166 66.09371818
## 438      v_lines 30.49808 62.38498503
## 439      v_lines 30.62023 60.86008215
## 440      v_lines 30.49219 55.87891689
## 441      v_lines 30.47463 52.32215964
## 442      v_lines 30.50100 48.06969968
## 443      v_lines 30.49442 45.77347553
## 444      v_lines 30.49954 49.38209975
## 445      v_lines 50.14439 47.01428364
## 446      v_lines 49.91290 55.58783891
## 447      v_lines 50.33743 57.95531428
## 448      v_lines 50.41898 60.52491173

```

```

## 449      v_lines 50.20526 57.92421717
## 450      v_lines 50.43532 56.43932247
## 451      v_lines 69.50579 59.28492483
## 452      v_lines 69.53407 64.89297733
## 453      v_lines 69.51011 61.32962443
## 454      v_lines 69.52632 56.99527913
## 455      v_lines 49.94724 48.22957673
## 456      v_lines 50.06310 58.08503756
## 457      v_lines 50.48990 39.20541197
## 458      v_lines 49.68886 42.01851441
## 459      v_lines 50.33348 43.58867148
## 460      v_lines 50.44675 57.23058894
## 461      v_lines 50.42091 43.34795690
## 462      v_lines 50.37405 32.91824062
## 463      v_lines 30.47683 39.42460559
## 464      v_lines 30.50347 38.34855614
## 465      v_lines 30.50483 28.77148799
## 466      v_lines 30.46222 32.75047203
## 467      v_lines 30.49130 43.56137408
## 468      v_lines 30.44965 44.99512300
## 469      v_lines 30.48599 47.34794647
## 470      v_lines 30.50208 36.44121292
## 471      v_lines 30.47806 28.02058049
## 472      v_lines 30.50116 38.31413856
## 473      v_lines 30.50477 26.41662567
## 474      v_lines 30.50912 22.82554712
## 475      v_lines 50.11563 16.69400655
## 476      v_lines 50.44830 21.64025646
## 477      v_lines 50.17318 29.17786439
## 478      v_lines 49.92274 38.44047291
## 479      v_lines 50.31130 26.86048827
## 480      v_lines 50.39941 38.96383892
## 481      v_lines 50.33736 40.91338614
## 482      v_lines 50.20232 47.21294800
## 483      v_lines 50.27493 49.62349934
## 484      v_lines 69.49438 52.61241071
## 485      v_lines 69.51934 47.38453371
## 486      v_lines 69.52918 57.84126668
## 487      v_lines 69.49576 58.78507316
## 488      v_lines 69.19906 60.41895732
## 489      v_lines 69.55109 58.40109827
## 490      v_lines 69.50668 68.08446679
## 491      v_lines 50.44412 75.01329951
## 492      v_lines 50.46723 90.28146451
## 493      v_lines 50.21088 80.94177171
## 494      v_lines 50.20541 90.64053590
## 495      v_lines 50.43829 92.35476027
## 496      v_lines 50.37352 82.21920572
## 497      v_lines 50.25368 81.74382872
## 498      v_lines 50.25047 71.95138521
## 499      v_lines 50.08706 73.95187363
## 500      v_lines 50.23107 80.64738706
## 501      v_lines 50.20774 73.11450352
## 502      v_lines 30.49951 53.61252767

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## 503      v_lines 30.52036 65.10040907
## 504      v_lines 30.45496 63.50177878
## 505      v_lines 50.41648 97.26969196
## 506      v_lines 69.52507 93.59805021
## 507      v_lines 69.52026 97.19387602
## 508      v_lines 69.49897 92.12048993
## 509      v_lines 69.52862 91.62208824
## 510      v_lines 69.49977 84.47968329
## 511      v_lines 69.50380 81.81540562
## 512      v_lines 69.48759 81.83598756
## 513      v_lines 69.51912 71.11596722
## 514      v_lines 69.50438 70.49344382
## 515      v_lines 69.51257 61.49756395
## 516      v_lines 89.49420 62.23432697
## 517      v_lines 89.50012 53.21633062
## 518      v_lines 89.49025 48.89079655
## 519      v_lines 89.49779 46.62990667
## 520      v_lines 89.50485 48.42340816
## 521      v_lines 89.50105 43.34734370
## 522      v_lines 89.48884 40.62509122
## 523      v_lines 89.50162 45.81517919
## 524      v_lines 89.49753 33.90137267
## 525      v_lines 50.43909 37.67077180
## 526      v_lines 50.17985 36.80755934
## 527      v_lines 69.50507 33.74015250
## 528      v_lines 69.57987 21.93523675
## 529      v_lines 69.50647 22.72866287
## 530      v_lines 69.49948 16.33746998
## 531      v_lines 69.50026 27.13602399
## 532      v_lines 69.50416 23.66891810
## 533      v_lines 69.53228 21.85090082
## 534      v_lines 69.50011 11.79162601
## 535      v_lines 69.50482 15.61435826
## 536      v_lines 69.50347 17.16908977
## 537      v_lines 50.37740 16.50601506
## 538      v_lines 50.33943 18.72345069
## 539      v_lines 50.09365 11.60771342
## 540      v_lines 49.93413 22.25613974
## 541      v_lines 50.28882 13.43641047
## 542      v_lines 50.28799 12.87228221
## 543      v_lines 50.23472 20.40447292
## 544      v_lines 50.27970 15.60873757
## 545      v_lines 50.25301 11.30208425
## 546      v_lines 50.47414 12.46199667
## 547      v_lines 50.10844 18.25904434
## 548      v_lines 49.91906  3.71685389
## 549      v_lines 50.08366 10.23588190
## 550      v_lines 50.35226 12.46860053
## 551      v_lines 50.49757  7.40962523
## 552      v_lines 50.01631 16.25368479
## 553      v_lines 50.46822 13.35670246
## 554      v_lines 69.55068  9.03298757
## 555      v_lines 69.51867 15.18048643
## 556      v_lines 69.50346 16.87831327

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## 557      v_lines 69.49949 10.20782668
## 558      v_lines 69.52753  9.99229667
## 559      v_lines 69.51910 11.42268570
## 560      v_lines 69.56190 15.99980379
## 561      v_lines 69.50104  5.95583354
## 562      v_lines 69.52464  2.73476017
## 563      v_lines 30.49959 26.08556157
## 564      v_lines 30.48739 19.77947037
## 565      v_lines 89.50018 31.97891744
## 566      v_lines 50.41027 98.62836944
## 567      v_lines 50.32592 94.99463085
## 568      v_lines 50.10403 95.08853802
## 569      x_shape 38.33776 92.47271905
## 570      x_shape 35.75187 94.11676803
## 571      x_shape 32.76722 88.51829458
## 572      x_shape 33.72961 88.62226579
## 573      x_shape 37.23825 83.72492841
## 574      x_shape 36.02720 82.04078065
## 575      x_shape 39.23928 79.26372384
## 576      x_shape 39.78452 82.26056590
## 577      x_shape 35.16603 84.15649198
## 578      x_shape 40.62212 78.54210421
## 579      x_shape 39.18191 79.81903720
## 580      x_shape 42.43089 75.13363464
## 581      x_shape 43.08126 75.34670164
## 582      x_shape 44.36072 70.47420705
## 583      x_shape 44.32478 71.04590440
## 584      x_shape 47.55216 66.46040372
## 585      x_shape 48.66492 64.96100494
## 586      x_shape 46.28063 68.02842315
## 587      x_shape 50.56324 62.62382797
## 588      x_shape 52.63096 59.96393579
## 589      x_shape 54.63621 57.49384244
## 590      x_shape 51.34603 61.60055304
## 591      x_shape 57.13486 53.87796580
## 592      x_shape 54.17124 58.05980790
## 593      x_shape 50.94238 62.09739394
## 594      x_shape 66.51292 59.07128185
## 595      x_shape 64.39791 56.17487540
## 596      x_shape 68.68659 62.23734399
## 597      x_shape 65.02779 57.09625735
## 598      x_shape 53.30450 40.88384455
## 599      x_shape 52.94518 40.38462569
## 600      x_shape 45.22574 30.55522592
## 601      x_shape 50.84330 37.74462810
## 602      x_shape 49.65929 36.27344274
## 603      x_shape 47.14279 32.02506417
## 604      x_shape 41.27006 21.72181715
## 605      x_shape 47.13013 31.30990292
## 606      x_shape 40.91597 23.54159239
## 607      x_shape 38.66016 21.68954964
## 608      x_shape 42.61255 24.19505377
## 609      x_shape 41.20904 24.12870919
## 610      x_shape 50.64922 37.48379074

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## 611      x_shape 52.13190 39.36460208
## 612      x_shape 39.79727 16.08354965
## 613      x_shape 43.54988 24.30721094
## 614      x_shape 36.71466 17.38180986
## 615      x_shape 37.22461 17.98006448
## 616      x_shape 40.51245 22.96221457
## 617      x_shape 40.22206 20.61462170
## 618      x_shape 44.12496 23.36624529
## 619      x_shape 42.34626 24.55832694
## 620      x_shape 44.18908 28.77262547
## 621      x_shape 45.81425 31.05697967
## 622      x_shape 46.64312 31.40721906
## 623      x_shape 52.18989 39.36779649
## 624      x_shape 51.10032 38.09569998
## 625      x_shape 65.40083 42.61403204
## 626      x_shape 64.85204 43.13373484
## 627      x_shape 63.40381 44.84749369
## 628      x_shape 65.37155 42.69597132
## 629      x_shape 61.90804 53.19035207
## 630      x_shape 71.82665 65.68623036
## 631      x_shape 72.65462 66.87827761
## 632      x_shape 76.88858 72.16547208
## 633      x_shape 43.74462 71.26796108
## 634      x_shape 39.05425 83.11902070
## 635      x_shape 39.93167 79.93918800
## 636      x_shape 39.76283 76.40596745
## 637      x_shape 41.32338 80.21186860
## 638      x_shape 41.78732 83.98807799
## 639      x_shape 39.75565 79.65709664
## 640      x_shape 40.74988 77.20465729
## 641      x_shape 43.85690 77.60984365
## 642      x_shape 42.36782 73.63827183
## 643      x_shape 39.46296 78.45997390
## 644      x_shape 44.51733 70.36934983
## 645      x_shape 41.63609 76.24922292
## 646      x_shape 45.42293 69.09550167
## 647      x_shape 42.00286 97.83761472
## 648      x_shape 76.10563 95.30498058
## 649      x_shape 79.20256 92.40721563
## 650      x_shape 84.84824 95.42480453
## 651      x_shape 81.56448 83.79290723
## 652      x_shape 85.44619 83.07829384
## 653      x_shape 80.31249 76.51623895
## 654      x_shape 80.76623 79.89606568
## 655      x_shape 82.67011 81.71147984
## 656      x_shape 77.16363 73.52371896
## 657      x_shape 74.07070 68.47956429
## 658      x_shape 74.11423 71.92636352
## 659      x_shape 68.94208 62.63515058
## 660      x_shape 73.24200 67.35327113
## 661      x_shape 71.86701 34.32915759
## 662      x_shape 71.56919 34.69921861
## 663      x_shape 71.48291 34.68051699
## 664      x_shape 78.12852 23.13923184

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## 665      x_shape 78.78983 25.59719335
## 666      x_shape 77.78155 23.44721447
## 667      x_shape 48.53063 34.15245001
## 668      x_shape 65.53078 42.28108470
## 669      x_shape 70.11803 36.44818479
## 670      x_shape 70.47226 36.08805306
## 671      x_shape 76.79113 28.07200817
## 672      x_shape 72.40935 33.03925697
## 673      x_shape 76.27130 25.56954415
## 674      x_shape 76.95326 27.77061074
## 675      x_shape 75.10773 30.01698342
## 676      x_shape 75.96929 29.03886538
## 677      x_shape 75.28389 24.87475317
## 678      x_shape 77.05224 27.90563909
## 679      x_shape 42.82676 25.55695941
## 680      x_shape 42.08066 24.94652645
## 681      x_shape 39.87830 18.32492922
## 682      x_shape 36.47550 17.71894779
## 683      x_shape 37.10307 15.44561165
## 684      x_shape 34.14897 13.52386987
## 685      x_shape 37.57942 15.01589013
## 686      x_shape 41.06431 12.21446893
## 687      x_shape 42.19527 20.91937219
## 688      x_shape 36.60558 15.74887589
## 689      x_shape 39.43116 19.32384075
## 690      x_shape 37.56208 11.92844570
## 691      x_shape 34.23811 13.71315823
## 692      x_shape 34.14094  4.57766135
## 693      x_shape 36.65927 17.68196446
## 694      x_shape 40.64372 20.24086137
## 695      x_shape 36.79248 13.39213473
## 696      x_shape 75.94830 22.74479591
## 697      x_shape 76.84069 20.91854722
## 698      x_shape 81.95048 19.87455821
## 699      x_shape 81.64371 16.59175998
## 700      x_shape 84.61022 14.24776190
## 701      x_shape 84.10288  8.98065579
## 702      x_shape 80.18003 19.08884413
## 703      x_shape 80.57327  8.36563890
## 704      x_shape 79.00433 10.62819777
## 705      x_shape 40.04819 24.26148793
## 706      x_shape 34.79459 13.96968346
## 707      x_shape 79.22176 22.09459148
## 708      x_shape 36.03088 93.12173324
## 709      x_shape 34.49956 86.60998505
## 710      x_shape 31.10687 89.46163524
## 711          star 58.21361 91.88189151
## 712          star 58.19605 92.21498865
## 713          star 58.71823 90.31053209
## 714          star 57.27837 89.90760672
## 715          star 58.08202 92.00814501
## 716          star 57.48945 88.08528556
## 717          star 28.08874 63.51079443
## 718          star 28.08547 63.59019695

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## 719	star	28.08727	63.12328281
## 720	star	27.57803	62.82103866
## 721	star	27.77992	63.51814752
## 722	star	28.58900	63.02408057
## 723	star	28.73914	62.72086389
## 724	star	27.02460	62.90185886
## 725	star	28.80134	63.38904039
## 726	star	27.18646	63.55872965
## 727	star	29.28515	63.38360583
## 728	star	39.40295	51.15085720
## 729	star	28.81133	61.35785406
## 730	star	34.30396	56.54212591
## 731	star	29.60276	60.15734672
## 732	star	49.11616	63.66000062
## 733	star	39.61755	62.92518796
## 734	star	43.23308	63.16521872
## 735	star	64.89279	65.81417676
## 736	star	62.49015	74.58428961
## 737	star	68.98808	63.23214730
## 738	star	62.10562	75.99087076
## 739	star	32.46185	62.88190292
## 740	star	41.32720	49.07025127
## 741	star	44.00715	46.44967378
## 742	star	44.07406	34.55320389
## 743	star	44.00132	33.90420735
## 744	star	45.00630	38.29901955
## 745	star	44.44384	36.01908330
## 746	star	42.17871	26.49211948
## 747	star	44.04457	35.66223828
## 748	star	41.64045	27.09309542
## 749	star	41.93833	24.99152298
## 750	star	44.05393	33.55639249
## 751	star	39.20672	51.53371570
## 752	star	28.70445	61.77752540
## 753	star	31.70866	58.83775437
## 754	star	42.81171	30.02044842
## 755	star	43.30061	31.52642620
## 756	star	40.39863	16.34700838
## 757	star	40.43569	20.23267068
## 758	star	40.93655	16.91300484
## 759	star	39.66157	15.60935558
## 760	star	40.89926	20.79852895
## 761	star	41.96862	26.49707260
## 762	star	40.38341	21.39122552
## 763	star	56.53813	32.44424547
## 764	star	52.97069	29.04019669
## 765	star	54.62095	30.34452445
## 766	star	65.09904	27.24155756
## 767	star	63.05599	29.70909567
## 768	star	70.96014	41.25950129
## 769	star	69.89582	43.45375927
## 770	star	70.59589	41.96474387
## 771	star	69.64702	44.04444502
## 772	star	77.39298	63.37145906

## 773	star	64.40079	67.44871845
## 774	star	63.86896	70.21373883
## 775	star	56.59442	86.92700622
## 776	star	56.53134	87.49981107
## 777	star	59.65216	87.80946159
## 778	star	56.63651	85.63749556
## 779	star	58.67229	90.07716031
## 780	star	58.22161	90.41101877
## 781	star	57.91466	89.95380277
## 782	star	55.31551	80.25186069
## 783	star	54.57573	77.53628847
## 784	star	54.41309	78.22908659
## 785	star	55.07451	79.81754642
## 786	star	29.43296	60.80177654
## 787	star	29.42269	63.06846482
## 788	star	29.00561	63.39075133
## 789	star	58.46184	90.26532639
## 790	star	57.99780	92.15990861
## 791	star	57.54947	90.74890656
## 792	star	59.52993	88.32727415
## 793	star	58.24939	92.12968148
## 794	star	58.02451	91.69442117
## 795	star	58.38212	90.55347607
## 796	star	62.56676	77.74393476
## 797	star	72.17582	63.12892942
## 798	star	79.47276	63.40868612
## 799	star	80.35770	63.29543754
## 800	star	78.75724	53.33262001
## 801	star	82.54024	56.54105229
## 802	star	86.43590	59.79276181
## 803	star	79.48868	53.65167426
## 804	star	81.53042	56.02536457
## 805	star	79.18679	53.23479185
## 806	star	77.89906	51.82245833
## 807	star	75.13071	23.37244197
## 808	star	76.05801	16.38374969
## 809	star	57.61467	33.82244765
## 810	star	56.17140	32.11798877
## 811	star	66.28789	26.11710975
## 812	star	67.88172	24.23601841
## 813	star	64.02808	27.67268551
## 814	star	77.49665	14.94852356
## 815	star	77.63465	14.46185393
## 816	star	77.86373	14.61067765
## 817	star	77.33816	15.89005466
## 818	star	76.18042	15.91257375
## 819	star	77.25265	15.15151702
## 820	star	77.41338	15.22192798
## 821	star	76.73185	16.21684614
## 822	star	49.47111	25.06301931
## 823	star	42.47654	18.33847356
## 824	star	43.59512	19.99420098
## 825	star	50.33997	26.47139661
## 826	star	40.74898	16.18214166


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## 827      star 38.38653 14.58021515
## 828      star 38.40402 14.45194845
## 829      star 38.76428 14.36559047
## 830      star 41.47014 17.27803344
## 831      star 47.15540 22.37793253
## 832      star 39.58257 17.64845284
## 833      star 41.74024 17.82932431
## 834      star 39.31187 15.64071697
## 835      star 41.67985 17.74591901
## 836      star 39.08746 15.12230394
## 837      star 41.48150 18.04743744
## 838      star 77.60609 15.16287254
## 839      star 75.98266 16.30692238
## 840      star 76.94576 15.85847833
## 841      star 77.54372 15.25394915
## 842      star 77.58474 15.83003939
## 843      star 76.82230 15.59516532
## 844      star 77.34857 15.77452924
## 845      star 77.57315 14.78064583
## 846      star 77.97261 14.95569875
## 847      star 41.52892 24.91642519
## 848      star 43.72255 19.07732780
## 849      star 79.32608 52.90039129
## 850      star 56.66397 87.94012501
## 851      star 57.82179 90.69316655
## 852      star 58.24317 92.10432787
## 853 high_lines 57.61323 83.90517080
## 854 high_lines 51.27439 82.81798294
## 855 high_lines 50.75390 76.75412895
## 856 high_lines 37.02118 81.95447000
## 857 high_lines 42.88176 80.18477005
## 858 high_lines 37.15571 84.95411141
## 859 high_lines 38.73186 83.78935643
## 860 high_lines 31.00053 82.57948060
## 861 high_lines 25.98550 74.34938755
## 862 high_lines 23.71457 75.09804908
## 863 high_lines 23.07732 71.72053967
## 864 high_lines 24.93914 72.58028581
## 865 high_lines 17.89350 71.10968734
## 866 high_lines 23.67308 64.87083914
## 867 high_lines 23.74907 63.55717190
## 868 high_lines 32.21518 65.60095802
## 869 high_lines 29.43684 67.55452811
## 870 high_lines 40.05010 71.88903357
## 871 high_lines 37.57480 69.98874444
## 872 high_lines 49.31047 67.16876032
## 873 high_lines 47.34802 72.59161154
## 874 high_lines 50.15741 71.16172582
## 875 high_lines 58.21001 68.04453807
## 876 high_lines 56.60891 70.40894609
## 877 high_lines 52.83382 72.55188627
## 878 high_lines 61.81859 76.11282402
## 879 high_lines 61.72763 77.06923841
## 880 high_lines 62.19225 76.15681921

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```
## 881 high_lines 58.11877 73.11896147
## 882 high_lines 58.27041 35.59689504
## 883 high_lines 59.76653 32.62125160
## 884 high_lines 52.53553 27.17412294
## 885 high_lines 50.89252 29.14528394
## 886 high_lines 49.96755 28.46020333
## 887 high_lines 51.34788 27.36426023
## 888 high_lines 37.55512 24.53766384
## 889 high_lines 39.19959 23.68049566
## 890 high_lines 36.38272 25.23800523
## 891 high_lines 41.10069 26.55261322
## 892 high_lines 28.21781 28.28029248
## 893 high_lines 33.79707 28.69975074
## 894 high_lines 43.91939 27.79784459
## 895 high_lines 44.41640 28.94769233
## 896 high_lines 28.03760 26.80382436
## 897 high_lines 31.68958 26.66640021
## 898 high_lines 27.27961 19.25728097
## 899 high_lines 31.22188 26.44085578
## 900 high_lines 33.54581 20.08070810
## 901 high_lines 39.73633 23.49480698
## 902 high_lines 42.84184 20.33390044
## 903 high_lines 47.09373 26.99347063
## 904 high_lines 51.45366 26.02294175
## 905 high_lines 49.36771 22.00558070
## 906 high_lines 48.25348 29.27085553
## 907 high_lines 61.00296 30.01531443
## 908 high_lines 60.80656 27.86831349
## 909 high_lines 59.06743 26.78828402
## 910 high_lines 61.41463 31.03937506
## 911 high_lines 68.93437 31.61989309
## 912 high_lines 63.06524 34.23574659
## 913 high_lines 72.27252 67.64444379
## 914 high_lines 75.35988 75.42161458
## 915 high_lines 72.83363 72.11469381
## 916 high_lines 70.81041 79.35046183
## 917 high_lines 45.80193 81.65826775
## 918 high_lines 45.83502 82.74259199
## 919 high_lines 40.07881 80.24718526
## 920 high_lines 51.98292 82.20438347
## 921 high_lines 57.33791 84.99951887
## 922 high_lines 62.33623 83.24656790
## 923 high_lines 58.50591 81.74558634
## 924 high_lines 56.24794 83.51394949
## 925 high_lines 55.40652 80.26667197
## 926 high_lines 53.28397 84.26359922
## 927 high_lines 44.67676 80.23828555
## 928 high_lines 30.01126 68.14675637
## 929 high_lines 29.74525 74.40452683
## 930 high_lines 37.30995 72.58615520
## 931 high_lines 61.13595 82.53756936
## 932 high_lines 61.72062 85.70569345
## 933 high_lines 63.60938 83.36002884
## 934 high_lines 70.72372 87.15220752
```

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## 935 high_lines 75.00639 82.42583516
## 936 high_lines 75.09255 83.43739071
## 937 high_lines 70.32793 82.02935470
## 938 high_lines 70.86333 79.40817475
## 939 high_lines 75.77990 79.88619942
## 940 high_lines 78.09366 77.75955818
## 941 high_lines 76.74576 71.97336009
## 942 high_lines 78.46460 69.74930082
## 943 high_lines 76.74568 70.04405726
## 944 high_lines 85.16168 65.51240471
## 945 high_lines 91.80835 34.96559448
## 946 high_lines 91.88745 34.76925386
## 947 high_lines 92.24840 32.37715443
## 948 high_lines 91.78253 34.38429465
## 949 high_lines 96.08052 28.05360050
## 950 high_lines 92.24790 28.07075149
## 951 high_lines 57.66228 24.06060793
## 952 high_lines 59.84692 26.17771249
## 953 high_lines 64.06710 27.77650056
## 954 high_lines 60.98150 23.93429816
## 955 high_lines 59.96706 26.80258322
## 956 high_lines 62.70745 21.99550858
## 957 high_lines 69.19524 22.70979217
## 958 high_lines 65.59236 20.69417310
## 959 high_lines 64.61710 22.44314555
## 960 high_lines 59.19116 17.76790181
## 961 high_lines 55.83963 21.61856967
## 962 high_lines 59.00076 21.17100749
## 963 high_lines 56.45937 25.14456421
## 964 high_lines 52.35811 19.41705412
## 965 high_lines 51.81166 17.03349460
## 966 high_lines 54.22285 19.50366554
## 967 high_lines 49.01876 23.48927402
## 968 high_lines 35.65358 17.51450806
## 969 high_lines 46.96579 16.78920162
## 970 high_lines 49.58424 16.75791601
## 971 high_lines 51.85630 21.96908401
## 972 high_lines 55.95289 16.78975760
## 973 high_lines 51.66379 19.92512520
## 974 high_lines 45.85967 17.12890368
## 975 high_lines 39.74038 18.74105141
## 976 high_lines 52.81122 17.85498812
## 977 high_lines 56.78910 17.30611552
## 978 high_lines 54.11453 17.67353439
## 979 high_lines 55.57112 17.36957458
## 980 high_lines 65.30646 18.19735483
## 981 high_lines 66.99075 17.22287065
## 982 high_lines 72.15672 16.81427479
## 983 high_lines 70.98058 17.15575228
## 984 high_lines 72.22208 19.36928170
## 985 high_lines 79.70016 20.74021837
## 986 high_lines 64.24916 14.91396246
## 987 high_lines 66.94329 20.18913250
## 988 high_lines 66.94168 18.24350939
```

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## 989 high_lines 39.64827 22.73136637
## 990 high_lines 37.94978 26.52174923
## 991 high_lines 86.50439 34.89402529
## 992 high_lines 50.81549 78.95083881
## 993 high_lines 51.18347 85.12885465
## 994 high_lines 40.86386 82.92614530
## 995      dots 51.14792 90.86741233
## 996      dots 50.51713 89.10239459
## 997      dots 50.20748 85.46004740
## 998      dots 50.06948 83.05766953
## 999      dots 50.56285 82.93782178
## 1000     dots 50.28853 82.97525357
## 1001     dots 25.58348 82.91489113
## 1002     dots 25.48358 82.92908498
## 1003     dots 25.44353 82.87420050
## 1004     dots 25.56511 82.92409777
## 1005     dots 25.92884 82.82118411
## 1006     dots 27.55148 51.48738653
## 1007     dots 27.53047 51.41484656
## 1008     dots 27.09557 52.07679944
## 1009     dots 27.43925 51.71207905
## 1010     dots 27.87826 50.70890793
## 1011     dots 27.33887 51.65304675
## 1012     dots 27.67840 51.18198917
## 1013     dots 52.63566 51.41855226
## 1014     dots 52.02521 52.12301105
## 1015     dots 52.88116 50.62155476
## 1016     dots 52.95261 50.07473901
## 1017     dots 52.52055 51.50244210
## 1018     dots 52.34282 51.86195209
## 1019     dots 51.92759 52.25779061
## 1020     dots 52.71377 51.19794432
## 1021     dots 50.44380 82.94182882
## 1022     dots 50.21670 83.75234297
## 1023     dots 52.18418 51.97525067
## 1024     dots 52.79210 51.07339565
## 1025     dots 52.58972 51.33809020
## 1026     dots 52.02885 52.17683750
## 1027     dots 52.72925 51.20176505
## 1028     dots 52.88431 50.44143545
## 1029     dots 52.50930 51.41620515
## 1030     dots 50.86268 17.14563109
## 1031     dots 50.89149 17.14132373
## 1032     dots 25.85513 17.08190869
## 1033     dots 26.02564 16.92501353
## 1034     dots 27.89317 50.66196341
## 1035     dots 27.63997 51.39909748
## 1036     dots 27.89266 50.79528152
## 1037     dots 52.79773 50.68603709
## 1038     dots 27.58064 51.52476126
## 1039     dots 26.49140 17.40539097
## 1040     dots 25.98532 17.20372213
## 1041     dots 26.20142 17.09382391
## 1042     dots 25.85757 17.11384266

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## 1043	dots	50.70468	17.02374454
## 1044	dots	50.81198	17.11492526
## 1045	dots	50.56485	17.07777732
## 1046	dots	50.93930	16.98102188
## 1047	dots	50.45885	17.03857897
## 1048	dots	52.90136	50.69056272
## 1049	dots	52.68495	51.29446922
## 1050	dots	52.50009	51.59435617
## 1051	dots	51.83564	52.33576553
## 1052	dots	76.99541	52.04552865
## 1053	dots	77.31060	51.74673004
## 1054	dots	77.92604	50.31866042
## 1055	dots	77.25439	51.46182482
## 1056	dots	76.24316	52.12368985
## 1057	dots	77.08448	51.96713670
## 1058	dots	75.22805	82.98566202
## 1059	dots	50.65835	83.11447934
## 1060	dots	50.20337	82.98265686
## 1061	dots	50.92955	82.84604113
## 1062	dots	50.17867	83.18462233
## 1063	dots	50.42270	82.90990147
## 1064	dots	50.46422	82.93532841
## 1065	dots	50.44927	83.96992038
## 1066	dots	49.92838	82.99366549
## 1067	dots	50.48801	83.09951912
## 1068	dots	49.96491	83.70831770
## 1069	dots	50.75211	82.90195010
## 1070	dots	27.42243	51.43887623
## 1071	dots	27.67408	51.30411215
## 1072	dots	27.53740	51.59365408
## 1073	dots	52.26335	94.24932783
## 1074	dots	51.73728	92.97911753
## 1075	dots	75.87096	88.38644174
## 1076	dots	75.24433	83.90349738
## 1077	dots	75.19830	83.46230334
## 1078	dots	75.70104	82.91945886
## 1079	dots	75.47934	82.88405139
## 1080	dots	75.19457	82.93211578
## 1081	dots	74.82025	82.96238879
## 1082	dots	75.16434	83.03499717
## 1083	dots	75.26336	82.94527930
## 1084	dots	77.75642	51.15177033
## 1085	dots	77.95444	50.47557897
## 1086	dots	77.08334	52.15779927
## 1087	dots	76.06355	52.10465206
## 1088	dots	77.68202	51.16563781
## 1089	dots	76.87808	51.86756230
## 1090	dots	76.94850	51.90751654
## 1091	dots	77.86405	49.66254553
## 1092	dots	75.77145	17.11125121
## 1093	dots	52.33157	51.87886035
## 1094	dots	52.59282	51.39159152
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## 1099	dots	75.87099	17.13489391
## 1100	dots	75.60588	17.06772306
## 1101	dots	75.89558	17.16994971
## 1102	dots	75.74656	17.10571651
## 1103	dots	75.14234	16.75492389
## 1104	dots	50.66178	17.07814052
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## 1106	dots	50.91894	17.14760476
## 1107	dots	50.72526	16.90746981
## 1108	dots	51.26387	17.16234971
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## 1111	dots	50.50140	17.10577072
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## 1115	dots	51.01423	17.22109553
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## 1120	dots	50.79235	17.20421434
## 1121	dots	50.55128	17.08465518
## 1122	dots	50.55976	17.09388377
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## 1131	dots	50.37826	16.94627981
## 1132	dots	50.53364	17.01958137
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## 1148	circle	32.64425	70.73255503
## 1149	circle	26.66665	62.98097121
## 1150	circle	26.45926	62.63467337

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## 1151    circle 25.53801 60.63023611
## 1152    circle 26.32071 62.39628112
## 1153    circle 26.16339 62.02681490
## 1154    circle 25.21379 60.27339860
## 1155    circle 26.85953 63.14183467
## 1156    circle 31.76067 69.79765539
## 1157    circle 39.79329 75.80796422
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## 1159    circle 53.77146 79.30293164
## 1160    circle 56.45143 79.24710702
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## 1162    circle 56.92584 79.20631862
## 1163    circle 58.98825 78.91725896
## 1164    circle 57.90227 79.08086782
## 1165    circle 64.81287 77.48693892
## 1166    circle 60.34979 78.72944587
## 1167    circle 48.89056 16.80654352
## 1168    circle 47.54951 17.07140452
## 1169    circle 30.88943 26.32903723
## 1170    circle 28.97284 29.05046892
## 1171    circle 35.16136 22.78684965
## 1172    circle 45.87037 17.48939337
## 1173    circle 32.83142 24.79753815
## 1174    circle 39.48557 20.03305005
## 1175    circle 33.44618 24.19064341
## 1176    circle 21.86358 46.05259335
## 1177    circle 25.16587 35.76661395
## 1178    circle 22.95948 51.28770679
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## 1181    circle 33.03730 24.56446249
## 1182    circle 36.46889 21.87611447
## 1183    circle 26.51355 32.91874982
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## 1186    circle 45.04108 17.73451773
## 1187    circle 47.35242 17.13474543
## 1188    circle 53.84619 16.38731810
## 1189    circle 55.12964 16.35324687
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## 1192    circle 82.14431 33.19522187
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## 1198    circle 73.03183 73.12057473
## 1199    circle 70.10280 75.68320685
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## 1202    circle 50.56493 79.07729855
## 1203    circle 53.71968 79.30693617
## 1204    circle 54.20023 79.32500234

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## 1205    circle 47.87520 78.67585343
## 1206    circle 51.47346 79.15986700
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## 1208    circle 48.56222 78.78238353
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## 1213    circle 32.26370 70.31663890
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## 1222    circle 65.11812 77.39918845
## 1223    circle 68.74563 75.79005545
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## 1225    circle 77.20459 69.31214977
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## 1232    circle 84.42479 38.76141016
## 1233    circle 85.57099 44.56009644
## 1234    circle 84.62672 39.48707751
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## 1236    circle 73.50745 22.85698876
## 1237    circle 63.35649 17.72406884
## 1238    circle 72.95905 22.51149983
## 1239    circle 64.02084 17.88358125
## 1240    circle 61.12446 17.11635336
## 1241    circle 75.67421 24.78250097
## 1242    circle 69.51358 20.27935789
## 1243    circle 58.57214 16.64270381
## 1244    circle 70.98194 21.14588810
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## 1246    circle 65.31504 18.33374830
## 1247    circle 64.01024 17.92447819
## 1248    circle 57.14094 16.59861054
## 1249    circle 56.36515 16.32654637
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## 1252    circle 42.87904 18.48941103
## 1253    circle 51.56699 16.48571364
## 1254    circle 58.83913 16.63763522
## 1255    circle 60.75579 17.03323151
## 1256    circle 54.76116 16.36618910
## 1257    circle 53.56991 16.33971255
## 1258    circle 48.91462 16.79863708

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## 1259      circle 52.64614 16.38483638
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## 1262      circle 65.80722 18.14076495
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## 1264      circle 63.39471 17.70053514
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## 1267      circle 65.75555 18.51621583
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## 1270      circle 61.82655 17.26965545
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## 1273      circle 45.02900 17.72444730
## 1274      circle 39.92136 19.70184953
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## 1276      circle 55.66296 83.35647962
## 1277      circle 50.49225 78.99753207
## 1278      circle 51.46710 79.20184458
## 1279      bullseye 51.20389 83.33977661
## 1280      bullseye 58.97447 85.49981761
## 1281      bullseye 51.87207 85.82973763
## 1282      bullseye 48.17993 85.04511674
## 1283      bullseye 41.68320 84.01794060
## 1284      bullseye 37.89042 82.56749300
## 1285      bullseye 39.54897 80.81260177
## 1286      bullseye 39.64957 82.66453387
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## 1288      bullseye 27.56084 72.84782559
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## 1291      bullseye 20.68915 62.72130521
## 1292      bullseye 19.28820 62.06305936
## 1293      bullseye 20.02450 61.34262387
## 1294      bullseye 35.46952 43.11588495
## 1295      bullseye 36.89433 47.70655597
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## 1301      bullseye 53.70378 66.38948204
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## 1306      bullseye 61.27979 65.76640250
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## 1308      bullseye 61.52059 64.79185504
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## 1310      bullseye 38.50220 41.56715562
## 1311      bullseye 48.66437 30.68066685
## 1312      bullseye 50.28525 30.33792211

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## 1313    bullseye 42.27633 34.52763612
## 1314    bullseye 54.03178 29.67234831
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## 1317    bullseye 40.07467 34.62368520
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## 1319    bullseye 34.76370 47.62479992
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## 1321    bullseye 36.45557 40.79184303
## 1322    bullseye 35.53766 48.72938687
## 1323    bullseye 20.40895 32.20303042
## 1324    bullseye 23.49571 25.32246815
## 1325    bullseye 29.55754 21.36477746
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## 1327    bullseye 53.98040 29.35098671
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## 1329    bullseye 59.50308 30.66967394
## 1330    bullseye 41.16378 34.31575825
## 1331    bullseye 48.99304 32.03035884
## 1332    bullseye 59.26928 29.64070177
## 1333    bullseye 45.46918 33.83119273
## 1334    bullseye 62.69127 30.29037383
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## 1336    bullseye 70.84643 52.28225333
## 1337    bullseye 71.53902 45.52180616
## 1338    bullseye 67.62087 38.00655847
## 1339    bullseye 72.47095 51.12213482
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## 1347    bullseye 49.19172 85.87622912
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## 1351    bullseye 46.48077 83.51821167
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## 1354    bullseye 36.03340 53.37168776
## 1355    bullseye 28.27119 72.84023126
## 1356    bullseye 25.05481 71.54859792
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## 1359    bullseye 50.42468 85.17474759
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## 1361    bullseye 63.14905 83.94685535
## 1362    bullseye 62.82402 84.96618595
## 1363    bullseye 70.23687 82.17115106
## 1364    bullseye 70.04274 80.38502135
## 1365    bullseye 72.57062 80.97121843
## 1366    bullseye 75.13072 79.98409314

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1367 bullseye 83.29391 70.77843179
1368 bullseye 79.66426 73.93230972
1369 bullseye 88.43210 64.62424700
1370 bullseye 89.11556 64.00150664
1371 bullseye 89.09220 57.76819305
1372 bullseye 91.72601 52.62335326
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1374 bullseye 91.50789 53.31265209
1375 bullseye 88.23900 31.47743488
1376 bullseye 88.53052 30.47603101
1377 bullseye 55.36516 30.44585028
1378 bullseye 62.56026 30.44713567
1379 bullseye 58.00667 30.25372130
1380 bullseye 55.06712 29.01153520
1381 bullseye 61.61478 29.99439119
1382 bullseye 68.54314 35.65783217
1383 bullseye 77.70611 20.30426019
1384 bullseye 68.45305 13.03552859
1385 bullseye 68.25721 12.38463915
1386 bullseye 70.25547 13.25038497
1387 bullseye 65.04433 11.00084148
1388 bullseye 60.09225 11.87211171
1389 bullseye 52.99203 9.90666848
1390 bullseye 50.14463 12.21154309
1391 bullseye 46.50861 11.20713449
1392 bullseye 43.80703 11.31894489
1393 bullseye 57.81785 10.94514243
1394 bullseye 50.94049 9.69154713
1395 bullseye 63.49732 11.91406917
1396 bullseye 50.01648 11.93385209
1397 bullseye 58.63677 11.97472107
1398 bullseye 54.73029 11.41288267
1399 bullseye 65.87555 11.73243636
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1403 bullseye 47.31542 12.85345178
1404 bullseye 55.05192 11.94998862
1405 bullseye 50.51596 9.76559162
1406 bullseye 49.67741 10.38313251
1407 bullseye 67.28066 14.12865153
1408 bullseye 66.17302 12.03791702
1409 bullseye 61.08854 10.08453441
1410 bullseye 66.05309 13.38022601
1411 bullseye 72.66999 15.23422594
1412 bullseye 61.50347 10.82841448
1413 bullseye 68.99503 13.99431053
1414 bullseye 78.24992 17.88324091
1415 bullseye 36.48198 15.16276009
1416 bullseye 50.96775 29.67977429
1417 bullseye 91.19105 46.67434284
1418 bullseye 55.86377 85.33648676
1419 bullseye 49.28059 84.04882283
1420 bullseye 43.36850 84.33217720

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## 1421 slant_up 47.69520 95.24118693
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## 1426 slant_up 42.65225 90.56063973
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## 1430 slant_up 27.54823 75.16475905
## 1431 slant_up 20.20978 67.51664210
## 1432 slant_up 24.44345 54.47365512
## 1433 slant_up 24.63083 53.39573890
## 1434 slant_up 21.03797 49.82929964
## 1435 slant_up 27.10624 54.71955315
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## 1441 slant_up 43.28671 43.05686032
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## 1443 slant_up 50.19896 52.22502959
## 1444 slant_up 55.76159 54.03051724
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## 1446 slant_up 70.17146 70.28222124
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## 1448 slant_up 63.76028 61.18564117
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## 1462 slant_up 47.22503 44.57564662
## 1463 slant_up 48.39236 50.33152856
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## 1473 slant_up 63.57294 32.93861761
## 1474 slant_up 59.02508 28.32208588

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## 1707 wide_lines 39.00272 92.26183816
## 1708 wide_lines 37.79530 93.53245536
## 1709 wide_lines 35.51390 89.59919011
## 1710 wide_lines 39.21945 83.54348184
## 1711 wide_lines 31.58820 77.02805242
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## 1713 wide_lines 31.64160 77.61083319
## 1714 wide_lines 30.98714 63.94402803
## 1715 wide_lines 27.43963 65.74446296
## 1716 wide_lines 30.57837 65.52194547
## 1717 wide_lines 28.80940 59.62100447
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## 1720 wide_lines 32.62846 54.06372049
## 1721 wide_lines 32.43865 49.90301949
## 1722 wide_lines 35.83829 53.35148834
## 1723 wide_lines 37.14204 49.74198795
## 1724 wide_lines 34.64455 54.44410778
## 1725 wide_lines 35.67540 49.62564335
## 1726 wide_lines 64.99459 49.46217283
## 1727 wide_lines 66.12915 61.64371789
## 1728 wide_lines 65.79065 55.94537372
## 1729 wide_lines 67.50178 60.85022747
## 1730 wide_lines 67.62951 61.42910607
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## 1732 wide_lines 66.54936 67.72558866
## 1733 wide_lines 64.05154 48.82009398
## 1734 wide_lines 68.19329 46.54354081
## 1735 wide_lines 65.27839 44.82035293
## 1736 wide_lines 34.99766 28.63299394
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## 1738 wide_lines 66.00445 52.68466915
## 1739 wide_lines 37.02326 32.11848168
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## 1744 wide_lines 30.34336 32.52456317

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## 1745 wide_lines 35.48333 44.49163493
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## 1778 wide_lines 38.79801 74.61063043
## 1779 wide_lines 34.67576 79.63759877
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## 1822 wide_lines 62.78663 13.91899310
## 1823 wide_lines 66.81768 11.41249716
## 1824 wide_lines 66.75502 18.08530514
## 1825 wide_lines 65.41553 10.46351221
## 1826 wide_lines 36.94633 13.51437750
## 1827 wide_lines 37.82543 9.60103430
## 1828 wide_lines 36.72284 9.33330211
## 1829 wide_lines 67.07332 6.04921458
## 1830 wide_lines 64.60182 12.00191696
## 1831 wide_lines 65.43728 15.54538608
## 1832 wide_lines 67.00402 15.34582664
## 1833 wide_lines 66.72419 5.24980548
## 1834 wide_lines 68.30762 13.28091652
## 1835 wide_lines 68.76805 13.52145655
## 1836 wide_lines 74.16727 5.34988087
## 1837 wide_lines 64.90036 16.24525837
## 1838 wide_lines 68.76343 8.70057294
## 1839 wide_lines 66.81691 12.27329434
## 1840 wide_lines 67.30935 0.21700627
## 1841 wide_lines 34.73183 19.60179507
## 1842 wide_lines 33.67444 26.09049021
## 1843 wide_lines 75.62726 37.12875195
## 1844 wide_lines 40.61013 89.13623987
## 1845 wide_lines 39.11437 96.48175132
## 1846 wide_lines 34.58383 89.58890199
```

Exercise 2

Now that you've loaded the data set, print out summary information, including:

- Number of columns
- Number of rows
- Classes of the columns
- Levels in the `dataset` column
- The range of the `x` column
- The range of the `y` column
- Number of missing values in each column

YOUR ANSWER GOES HERE:

```
#number of columns
ncol(dsaur)
```

```
## [1] 3
```

```
#number of rows
nrow(dsaur)
```

```
## [1] 1846
```

```
#classes of the columns
class(dsaur$dataset)
```

```
## [1] "character"
```

```
class(dsaur$x)
```

```
## [1] "numeric"
```

```
class(dsaur$y)
```

```
## [1] "numeric"
```

```
#levels in the "dataset" column
levels(factor(dsaur[,1]))
```

```
## [1] "away"      "bullseye"   "circle"     "dino"       "dots"
## [6] "h_lines"    "high_lines" "slant_down" "slant_up"   "star"
## [11] "v_lines"    "wide_lines" "x_shape"
```

```
#the range of the "x" column
max(dsaur$x) - min(dsaur$x)
```

```
## [1] 82.72737
```

```
#the range of the "y" column
max(dsaur$y) - min(dsaur$y)
```

```
## [1] 99.67956
```

```
#number of missing values in each column  
sum(is.na(dsaur$dataset))
```

```
## [1] 0
```

```
sum(is.na(dsaur$x))
```

```
## [1] 0
```

```
sum(is.na(dsaur$y))
```

```
## [1] 0
```

Exercise 3

The Datasaurus Dozen is actually a collection of 12 data sets stacked together. The **dataset** column indicates which data set each row comes from.

1. Use subsetting to extract only the rows in the **dino** data set. Assign those rows to the **dino** variable.
2. Compute the mean and standard deviation for the **x** and **y** columns in the **dino** data set.
3. Repeat part 3.1 and 3.2 for the **star** dataset.

Based on the statistics, are the two data sets similar?

YOUR ANSWER GOES HERE:

```
dino = subset(dsaur, dataset == 'dino')  
dino_x_mean = mean(dino$x)  
dino_y_mean = mean(dino$y)  
dino_x_sd = sd(dino$x)  
dino_y_sd = sd(dino$y)  
  
star = subset(dsaur, dataset == 'star')  
star_x_mean = mean(star$x)  
star_y_mean = mean(star$y)  
star_x_sd = sd(star$x)  
star_y_sd = sd(star$y)
```

Based on the values calculated in the in step 1 and step 2, the two data sets are very similar in terms of mean and standard deviation.

Exercise 4

Note: Exercise 4-5 use ggplot2, which will be covered in the week 5 lectures.

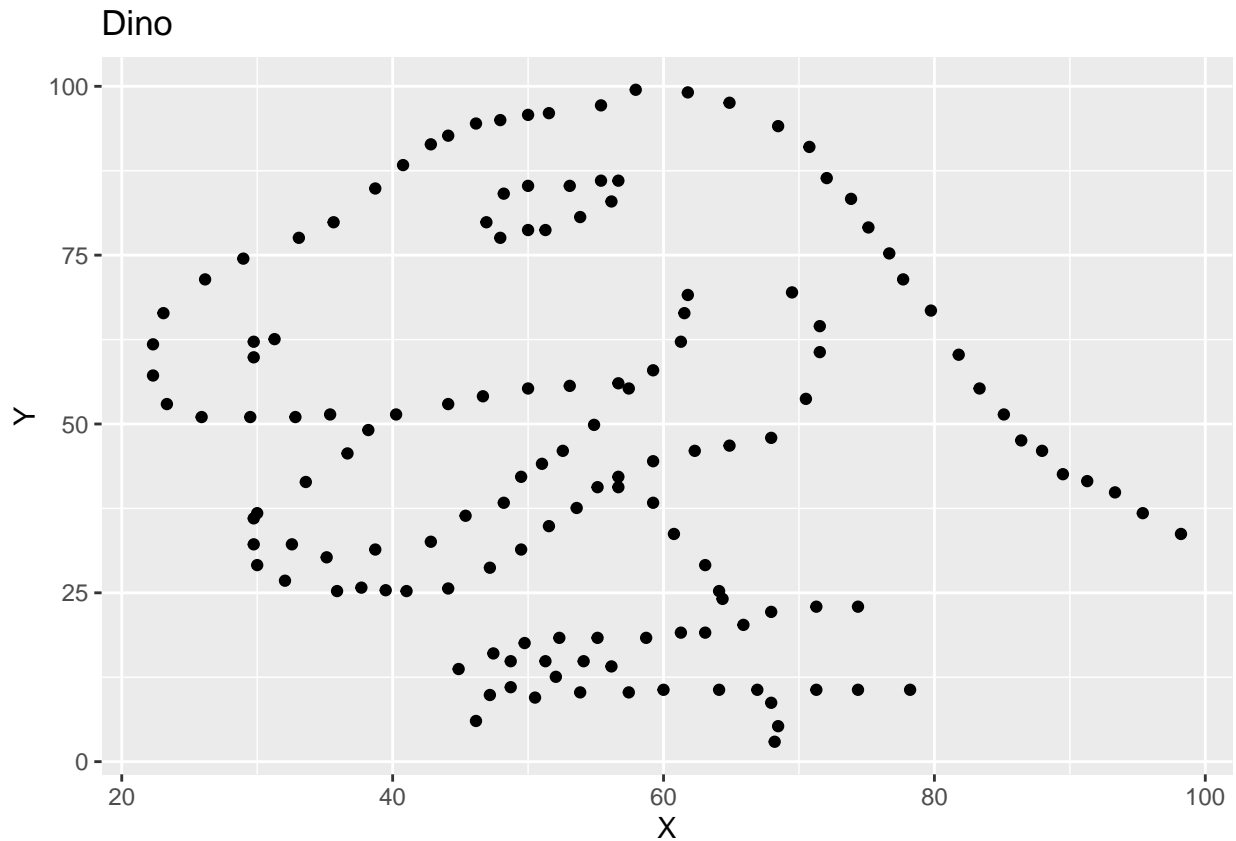
1. Use **ggplot2** to make a scatter plot of **x** versus **y** for the **dino** data set. Make sure your plot includes a title.

2. Repeat for the `star` data set.

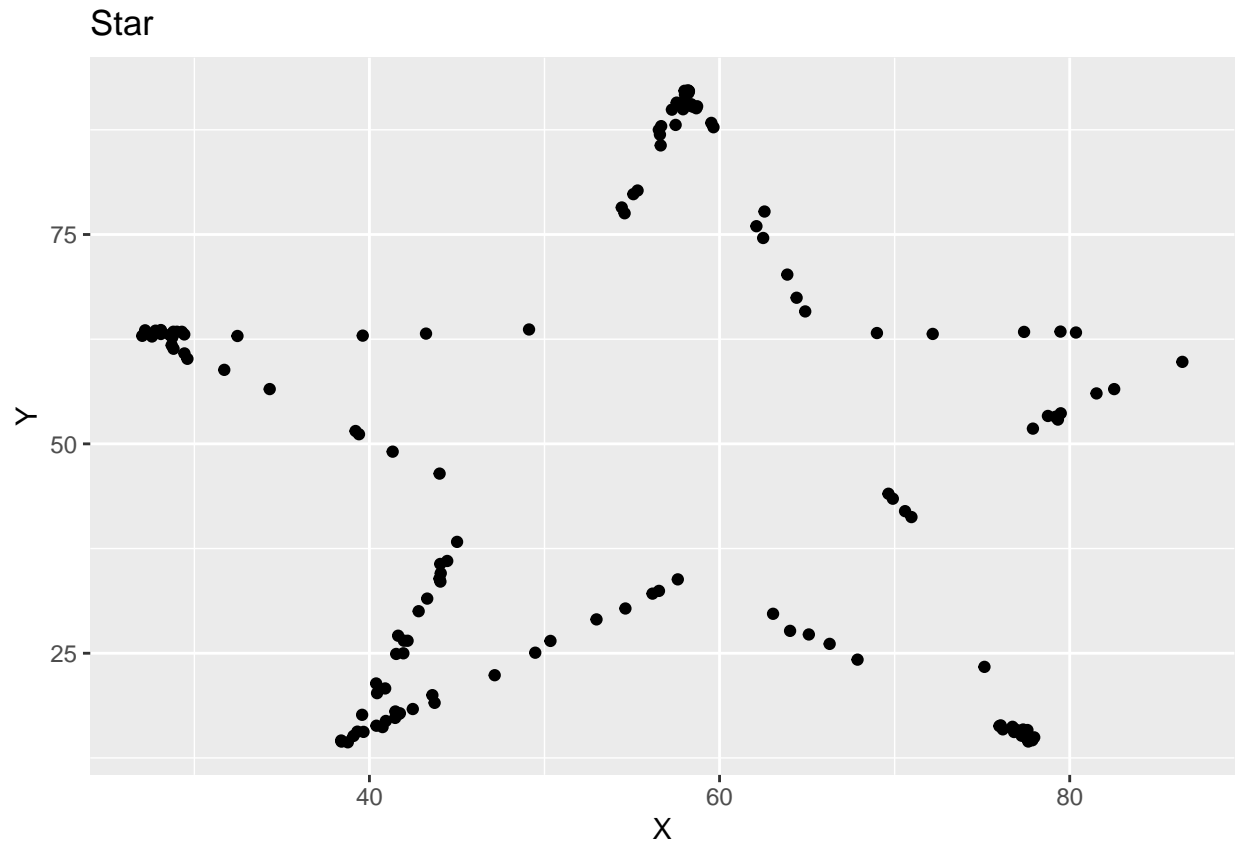
Based on these plots, are the two data sets similar?

YOUR ANSWER GOES HERE:

```
#install.packages("tidyr")
library(ggplot2)
ggplot(dino, aes(x = x, y = y)) + geom_point() +
  labs(title = "Dino", x = "X", y = "Y")
```



```
ggplot(star, aes(x = x, y = y)) + geom_point() +
  labs(title = "Star", x = "X", y = "Y")
```



These two data sets are not similar, as they're showing different patterns in their plots.

Exercise 5

A “faceted” plot is one that shows several subplots side-by-side, to aid comparison between them. Each subplot is called a “facet”.

You can create a faceted plot with ggplot2 by using the facet layer. For instance, the `facet_wrap()` function creates a line of facets based on a single categorical variable. The facet layer should be added to a plot *after* the geometry layers.

1. Read the documentation for `facet_wrap()`, then create a faceted scatter plot that shows each dataset from the Datasaurus Dozen in a separate facet. Use `geom_smooth` with `method = "lm"` to add a linear regression line to each facet.

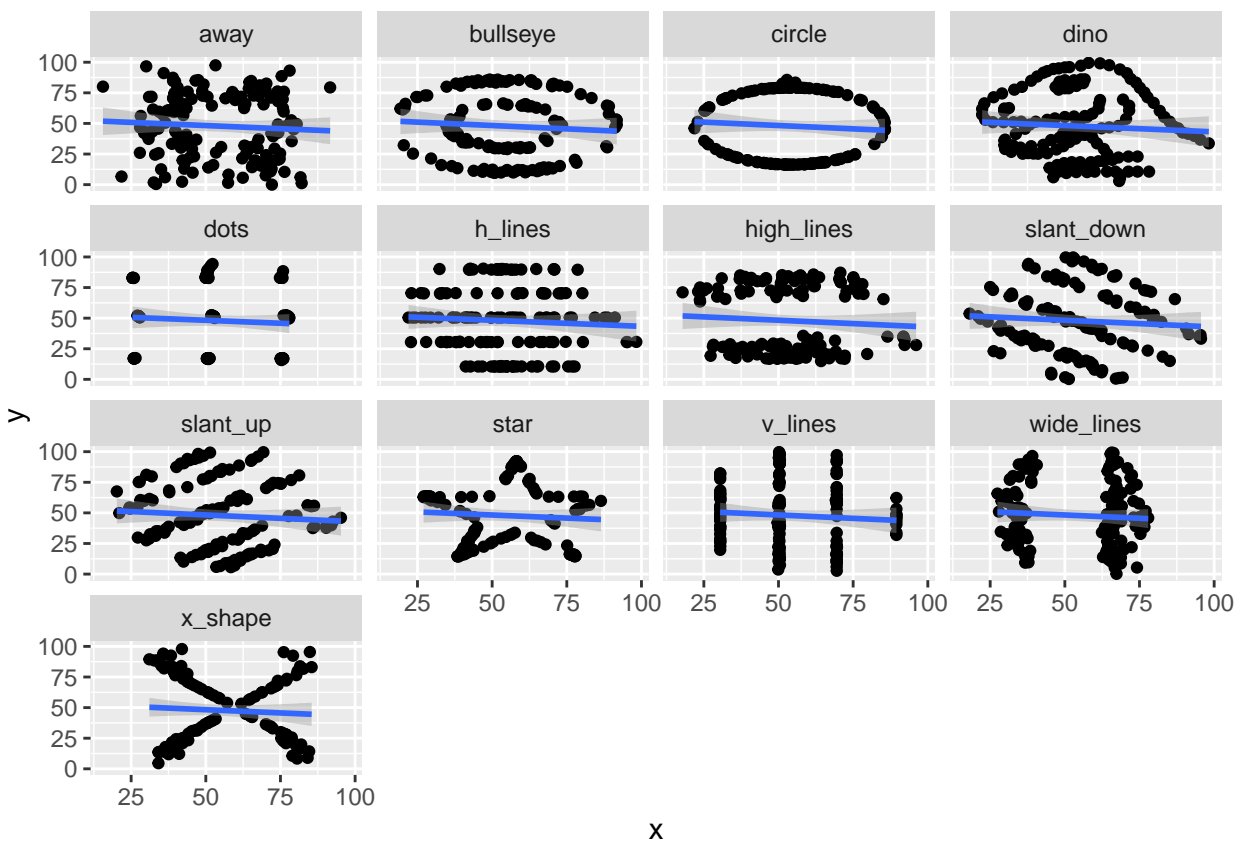
Hint: Unlike other ggplot2 functions, variable names in facet functions need to be enclosed in a call to the `vars()` function. So to write the column `dataset`, you would write `vars(dataset)`. See the `facet_wrap()` documentation for more details.

2. Is there any pattern to the regression lines across the different data sets?

YOUR ANSWER GOES HERE:

```
ggplot(dsaur, aes(x = x, y = y)) + geom_point() + facet_wrap(vars(dataset)) + geom_smooth(method = "lm")
```

```
## 'geom_smooth()' using formula 'y ~ x'
```



I found out the regression lines across the different data sets are quite similar, which all slightly slope downward.