In[ ]:=
```
SetDirectory[
  "C:/Users/serha/OneDrive/Masaüstü/MyRepo/master_thesis_MMT003/210224_impacts_in_time
    _windows"];
```

In[ ]:=
```
datafull = Import["datafull_manipulated.mx", HeaderLines → 1];
```

Handling Width and Thickness Null/Zero Values

Calculation through density for one unknown feature in a row

In[ ]:=
```
datacol[x_] := datafull[[All, x]]
densityfunction[weight_, denom1_, denom2_, denom3_] :=
 N@(weight / (denom1 * denom2 * denom3))
rowfunction[rownum_, density_] := {(datacol@9)[[rownum]], (datacol@10)[[rownum]],
  (datacol@12)[[rownum]], (datacol@11)[[rownum]], density}
```

In[ ]:=
```
MapThread[TableView[{{"WIDTH", "THICKNESS", "LENGTH", "WEIGHT", "DENSITY"},
    rowfunction[#1, dens = densityfunction[(datacol@11)[[#1]], (datacol@9)[[#1]],
       (datacol@10)[[#1]], (datacol@12)[[#1]]]], rowfunction[#2, dens],
    rowfunction[#3, dens], row5 = rowfunction[#4, dens]}, Alignment → Center,
   Background → {{{None, None, None, None, Red}}, {1 → Lighter@Gray}}] &,
 {{16742}, {16746}, {16747}, {16748}}]
Print["NA = ", widthforNA = densityfunction[row5[[4]], row5[[2]], row5[[3]], row5[[5]]]]
datafull[[16746 ;; 16748, 9]] = widthforNA;
```

Out[ ]=

	1	2	3	4	5	6
1	WIDTH	THICKNESS	LENGTH	WEIGHT	DENSITY	
2	1.54×10^{11}	6.5×10^{9}	3.5×10^{4}	1.6×10^{2}		
3	NA	6.5×10^{9}	2.2×10^{4}	1.6×10^{2}		
4	NA	6.5×10^{9}	2.2×10^{4}	1.6×10^{2}		
5	NA	6.5×10^{9}	2.2×10^{4}	1.6×10^{2}		
6						
7						
8						
9						
10						
11						
12						
13						
14						

NA = 2.45×10^{11}

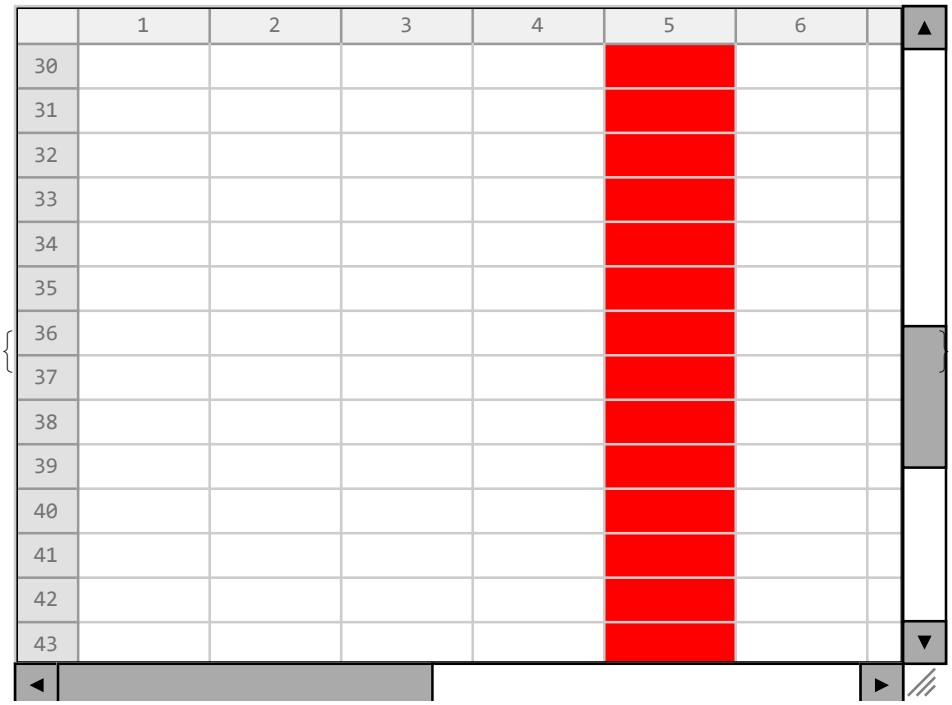
In[ ]:=
```
(* *
 If there is one NA value in a row, it is calculated by the common density value.
 * *)
```

In[•]:=
```
Partition[Range[47897, 47909], 1]
```

Out[•]=
```
{{47897}, {47898}, {47899}, {47900}, {47901}, {47902},
 {47903}, {47904}, {47905}, {47906}, {47907}, {47908}, {47909}}
```

In[•]:=
```
MapThread[TableView[{{"WIDTH", "THICKNESS", "LENGTH", "WEIGHT", "DENSITY"},
     rowfunction[#1, dens = densityfunction[(datacol@11)[[#1]], (datacol@9)[[#1]],
        (datacol@10)[[#1]], (datacol@12)[[#1]]]], rowfunction[#2, dens],
     rowfunction[#3, dens], row5 = rowfunction[#4, dens]}, Alignment → Center,
    Background → {{{None, None, None, None, Red}}, {1 → Lighter@Gray}}] &,
 {{16742}, {16746}, {16747}, {16748}}]
Print["NA = ", widthforNA = densityfunction[row5[[4]], row5[[2]], row5[[3]], row5[[5]]]]
datafull[[16746 ;; 16748, 9]] = widthforNA;
```

Out[•]=




```
NA = 2.45×10^11
```

In[•]:=
```
datafull = Delete[Delete[datafull, 459203], 459202];
(* The last two rows are deleted because all features have Null values *)
```

Handling two Null/Zero features in a row by looking back and forth patterns in same HEAT_ID and SEQUENCE _ID groups

In[ ]:=
```
densityfunction2[weight_, denom1_, denom2_, denom3_] :=
 If[denom1 == "NA" || denom1 == 0, "NA", If[denom2 == "NA" || denom2 == 0, "NA",
   If[denom3 == "NA" || denom3 == 0, "NA", weight / (denom1 * denom2 * denom3)]]]
rowfunction2[rownum_] := {(datacol@2)[[rownum]], (datacol@13)[[rownum]],
  (datacol@14)[[rownum]], (datacol@9)[[rownum]], (datacol@10)[[rownum]],
  (datacol@12)[[rownum]], (datacol@11)[[rownum]],
  densityfunction2[(datacol@11)[[rownum]], (datacol@9)[[rownum]],
   (datacol@10)[[rownum]], (datacol@12)[[rownum]]]}
heading = {"SEQUENCE_ID", "HEAT_ID", "STEEL_GRADE", "WIDTH",
   "THICKNESS", "LENGTH", "WEIGHT", "DENSITY"};
```

In[ ]:=
```
TableView[
 Partition[Flatten@Join[heading, Table[rowfunction2[i], {i, {47919, 47920, 47921, 47951,
       47952, 47953, 47967, 47968, 47969, 47978, 47979, 47980, 47981, 47982, 47983,
       47984, 47985, 48276, 48277, 48278, 48284, 48286, 48292, 48293, 48294, 48339,
       48340, 48341, 48347, 48348, 48349, 48350, 48351, 48352, 48353, 48354}}]], 8],
 Alignment → Center, Background → {{None, None, Red, Red, Red, Red, None, Red},
   {1 → Lighter@Gray}}]
```

Out[ ]=

	1	2	3	4	5	6	
1	SEQUENCE_ID	HEAT_ID	STEEL_GRADE	WIDTH	THICKNESS	LENGTH	W
2	693	17022321	34	1.24×10^{6}	65.	3.01×10^{9}	1.
3	693	17022321	34	1.24×10^{6}	65.	3.01×10^{9}	1.
4	693	17022321	34	1.24×10^{6}	65.	3.01×10^{9}	1.
5	693	17022321	34	1.22×10^{6}	65.	3.43×10^{9}	2.
6	693	17022321	34	1.22×10^{6}	65.	3.43×10^{9}	2.
7	693	17022321	34	1.22×10^{6}	65.	3.43×10^{9}	2.
8	693	17022321	34	1.22×10^{6}	65.	3.45×10^{9}	2.
9	693	17022321	34	1.22×10^{6}	65.	3.45×10^{9}	2.
10	693	17022321	34	1.22×10^{6}	65.	3.45×10^{9}	2.
11	693	17022321	NA	NA	NA	NA	1
12	693	17022321	NA	NA	NA	NA	1
13	693	17022321	NA	NA	NA	NA	1
14	693	17022321	NA	NA	NA	NA	1

In[ ]:=
```
(* *
  1- NA values in Steel Grade Feature are converted to "34" considering
  all steel grade values are "34" in the same sequence and heat id.
   2- NA values in Thickness Feature are converted to "65" considering
  all thickness values are "65" in the same sequence and heat id.
   3- Zero values in Width, Thickness, Length Features are at the end of the relevant
 sequence and heat group. Therefore they will be removed from the evaluation dataset.
 * *)
```

```
In[•]:= densityrelation[weight1_, weight2_, length1_] := N@weight2 * length1 / weight1

In[•]:= manipulator[data_, seq_, heat_, newwidth_, newthick_, newlength_,
          newstgr_, evaluationpart_] := Module[{initialdata, filtercon, part, pos},
          initialdata = data;
          filtercon = Select[initialdata, #[[2]] == seq && #[[13]] == heat &];
          part = Join[filtercon[[All, 1 ;; 2]], filtercon[[All, 9 ;; 14]], 2];
          pos =
           Take[Sort@Join[If[MemberQ[part[[All, 3]], "NA"], Position[part[[All, 3]], "NA"], {}],
              If[MemberQ[part[[All, 3]], 0], Position[part[[All, 3]], 0], {}]], evaluationpart];
          initialdata[[part[[Flatten@pos, 1]], 9]] = newwidth;
          initialdata[[part[[Flatten@pos, 1]], 10]] = newthick;
          initialdata[[part[[Flatten@pos, 1]], 12]] = newlength;
          initialdata[[part[[Flatten@pos, 1]], 14]] = newstgr;
          initialdata]

In[•]:= datafull1 = manipulator[datafull, 693, 17 022 341, 1 220 000.0, 65.,
           densityrelation[2 080 000 000.0, 10 000 000.0, 3 430 000 000.0], 34, All];

In[•]:= datafull2 = manipulator[datafull1, 693, 17 022 321, 1 220 000.0,
           65., densityrelation[2 080 000 000.0, 10 000 000.0, 3 430 000 000.0], 34, 8];

In[•]:= datafull3 = manipulator[datafull2, 259, 17 003 161, 1 850 000.0, 65.,
           densityrelation[2 200 000 000.0, 2 820 000 000.0, 2 410 000 000.0], 30, All];

In[•]:= datafull4 = manipulator[datafull3, 259, 17 003 141, 1 850 000.0, 65.,
           densityrelation[2 640 000 000.0, 65 300 000.0, 2 890 000 000.0], 30, All];

In[•]:= datafull5 = manipulator[datafull4, 259, 17 003 121, 1 870 000.0, 65.,
           densityrelation[2 140 000 000.0, 325 000 000.0, 2 320 000 000.0], 30, All];

In[•]:= datafull6 = manipulator[datafull5, 259, 17 003 101, 1 860 000.0, 65.,
           densityrelation[2 190 000 000.0, 435 000 000.0, 2 390 000 000.0], 30, All];

In[•]:= datafull7a = manipulator[datafull6, 323, 17 004 401, 1 840 000.0,
           66., densityrelation[2 100 000 000.0, 335 000 000.0, 2 290 000 000.0], 30, 7];

In[•]:= datafull7b = manipulator[datafull7a, 323, 17 004 401, 1 840 000.0, 66.,
           densityrelation[2 190 000 000.0, 335 000 000.0, 2 380 000 000.0], 30, -7];

In[•]:= datafull8 = manipulator[datafull7b, 714, 17 023 421, 1.84 * 10^6,
           65., densityrelation[2.62 * 10^9, 2.4 * 10^7, 2.88 * 10^9], 41, All];

In[•]:= datafull9 = manipulator[datafull8, 714, 17 023 441, 1.85 * 10^6,
           65., densityrelation[3.52 * 10^9, 1.9 * 10^8, 3.85 * 10^9], 41, All];

In[•]:= datafull10 = manipulator[datafull9, 714, 17 023 461, 1.84 * 10^6,
           65., densityrelation[2.64 * 10^9, 1.0 * 10^7, 2.91 * 10^9], 41, All];

In[•]:= datafull11 = manipulator[datafull10, 714, 17 023 501, 1.84 * 10^6,
           65., densityrelation[2.07 * 10^9, 1.30 * 10^8, 2.28 * 10^9], 35, All];
```

```
In[ ]:= datafull12 = manipulator[datafull11, 714, 17023521, 1.84 * 10^6,
          65., densityrelation[2.08 * 10^9, 8.00 * 10^7, 2.29 * 10^9], 34, All];

In[ ]:= datafull13 = manipulator[datafull12, 714, 17023541, 1.84 * 10^6,
          65., densityrelation[3.53 * 10^9, 1.10 * 10^8, 3.88 * 10^9], 34, All];

In[ ]:= (*weightcorrection*)datafull13[[51111 ;; 51115, 11]] = 1.10 * 10^8;

In[ ]:= datafull14 = manipulator[datafull13, 714, 17023561, 1.84 * 10^6,
          65., densityrelation[2.18 * 10^9, 3.0 * 10^7, 2.41 * 10^9], 34, -7];

In[ ]:= datafull15 = manipulator[datafull14, 714, 17023561, 1.84 * 10^6,
          65., densityrelation[3.52 * 10^9, 3.0 * 10^7, 3.88 * 10^9], 34, 7];

In[ ]:= datafull16 = manipulator[datafull15, 714, 17023601, 1.84 * 10^6,
          65., densityrelation[2.1 * 10^9, 1.8 * 10^8, 2.32 * 10^9], 34, All];

In[ ]:= (*weightcorrection*)datafull16[[50883 ;; 50887, 11]] = 2.0 * 10^7;

In[ ]:= datafull17 = manipulator[datafull16, 714, 17023621, 1.84 * 10^6,
          65., densityrelation[2.08 * 10^9, 1.2 * 10^8, 2.29 * 10^9], 34, All];

In[ ]:= datafull18 = manipulator[datafull17, 714, 17023641, 1.84 * 10^6,
          65., densityrelation[3.43 * 10^9, 1.0 * 10^7, 3.79 * 10^9], 26, All];

In[ ]:= datafull19 = manipulator[datafull18, 714, 17023661, 1.84 * 10^6,
          65., densityrelation[2.16 * 10^9, 1.7 * 10^8, 2.39 * 10^9], 26, All];

In[ ]:= datafull20 = manipulator[datafull19, 714, 17023681, 1.84 * 10^6,
          65., densityrelation[2.16 * 10^9, 8.0 * 10^7, 2.39 * 10^9], 26, All];

In[ ]:= datafull21 = manipulator[datafull20, 714, 17023701, 1.84 * 10^6,
          65., densityrelation[2.17 * 10^9, 3.0 * 10^7, 2.4 * 10^5], 26, All];

In[ ]:= datafull22 = manipulator[datafull21, 714, 17023721, 1.84 * 10^6,
          65., densityrelation[2.1 * 10^9, 1.0 * 10^7, 2.32 * 10^9], 26, All];

In[ ]:= datafull23 = manipulator[datafull22, 714, 17023741, 1.84 * 10^6,
          65., densityrelation[2.18 * 10^9, 2.0 * 10^7, 2.41 * 10^9], 41, All];

In[ ]:= (*weightcorrection*)datafull23[[51158 ;; 51163, 11]] = 2.0 * 10^7;
```

```
In[•]:= manipulator2[data_, seq_] := Module[{initialdata, filtercon, part,
          pos, newwidth, newthick, firstlength, firstweight, newlength, newstgr},
        initialdata = data;
        filtercon = Select[initialdata, #[[2]] == seq &];
        part = Join[filtercon[[All, 1 ;; 2]], filtercon[[All, 9 ;; 14]], 2];
        pos = Split[Flatten@Take[
            Sort@Join[If[MemberQ[part[[All, 3]], "NA"], Position[part[[All, 3]], "NA"], {}],
              If[MemberQ[part[[All, 3]], 0], Position[part[[All, 3]], 0], {}]], All],
          #2 - #1 == 1 &];
        newwidth = Table[part[[pos[[i]][[1]] - 1, 3]], {i, Length@pos}];
        newthick = Table[part[[pos[[i]][[1]] - 1, 4]], {i, Length@pos}];
        firstlength = Table[part[[pos[[i]][[1]] - 1, 6]], {i, Length@pos}];
        firstweight = Table[part[[pos[[i]][[1]] - 1, 5]], {i, Length@pos}];
        newlength = Table[
          N@part[[pos[[i]][[1]], 5]] * firstlength[[i]] / firstweight[[i]], {i, Length@pos}];
        newstgr = Table[part[[pos[[i]][[1]] - 1, 8]], {i, Length@pos}];
        Table[initialdata[[part[[pos[[i]], 1]], 9]] = newwidth[[i]], {i, Length@pos}];
        Table[initialdata[[part[[pos[[i]], 1]], 10]] = newthick[[i]], {i, Length@pos}];
        Table[initialdata[[part[[pos[[i]], 1]], 12]] = newlength[[i]], {i, Length@pos}];
        Table[initialdata[[part[[pos[[i]], 1]], 14]] = newstgr[[i]], {i, Length@pos}];
        initialdata]

In[•]:= (*weight corrections*)
    datafull23[[63465 ;; 63470, 11]] = 84.5 * 10^8;
    datafull23[[63739 ;; 63743, 11]] = 93.5 * 10^8;
    datafull23[[63918 ;; 63924, 11]] = 84.5 * 10^8;
    datafull23[[63968 ;; 63975, 11]] = 84.5 * 10^8;
    datafull23[[64048 ;; 64054, 11]] = 85.0 * 10^8;

In[•]:= datafull24 = manipulator2[datafull23, 792];

In[•]:= (*weight corrections*)
    datafull24[[64506 ;; 64512, 11]] = 83.0 * 10^8;

In[•]:= datafull25 = manipulator2[datafull24, 793];

In[•]:= (*length correction*)
    datafull25[[64647 ;; 64650, 12]] = 9.5 * 10^9;

In[•]:= (*weight corrections*)
    datafull25[[65255 ;; 65258, 11]] = 85.0 * 10^8;

In[•]:= datafull26 = manipulator2[datafull25, 795];

In[•]:= (*width, thickness, length corrections*)
    datafull26[[68017 ;; 68023, 9]] = 1.53 * 10^6;
    datafull26[[68017 ;; 68023, 10]] = 73;
    datafull26[[68017 ;; 68023, 12]] = 2.3 * 10^6;
```

```
In[ ]:= (*weight corrections*)
        datafull26[[68043 ;; 68047, 11]] = 85.5 * 10^8;
        datafull26[[68110 ;; 68116, 11]] = 85 * 10^8;

In[ ]:= datafull27 = manipulator2[datafull26, 853];

In[ ]:= (*width corrections*)
        datafull27[[68322 ;; 68328, 9]] = 1.52 * 10^6;

In[ ]:= datafull28 = manipulator2[datafull27, 862];

In[ ]:= (*width corrections*)
        datafull28[[72340 ;; 72345, 9]] = 1.53 * 10^6;
        datafull28[[72388 ;; 72395, 9]] = 1.53 * 10^6;
        datafull28[[72400 ;; 72404, 9]] = 1.53 * 10^6;
        datafull28[[72410 ;; 72434, 9]] = 1.53 * 10^6;
        datafull28[[72624 ;; 72646, 9]] = 1.53 * 10^6;
        datafull28[[72652 ;; 72656, 9]] = 1.53 * 10^6;
        datafull28[[72760 ;; 72762, 9]] = 1.33 * 10^6;
        datafull28[[72874 ;; 72882, 9]] = 1.53 * 10^6;
        datafull28[[73004 ;; 73022, 9]] = 1.53 * 10^6;
        datafull28[[73027 ;; 73030, 9]] = 1.53 * 10^6;
        datafull28[[73078 ;; 73084, 9]] = 1.45 * 10^6;

In[ ]:= (*length corrections*)
        datafull28[[72364 ;; 72369, 12]] = 2.84 * 10^9;
        datafull28[[72887 ;; 72891, 12]] = 4.04 * 10^9;

In[ ]:= (*weight corrections*)
        datafull28[[72405 ;; 72409, 11]] = 84.5 * 10^8;
        datafull28[[72692 ;; 72697, 11]] = 2.19 * 10^9;

In[ ]:= datafull29 = manipulator2[datafull28, 877];

In[ ]:= (*weight corrections*)
        datafull29[[83448 ;; 83454, 11]] = 2.0 * 10^7;
        (* above/left items` density is 7.42*10^-11 *)
        datafull29[[83514 ;; 83520, 11]] = 4.0 * 10^7;

In[ ]:= (*width, thickness, weight,length and/or st.gr. corrections*)
        datafull29[[83549 ;; 83554, 9]] = 1.54 * 10^6;
        datafull29[[83549 ;; 83554, 10]] = 76;
        datafull29[[83549 ;; 83554, 11]] = 1.5 * 10^9;
        datafull29[[83549 ;; 83554, 12]] = 2.36 * 10^9;

        datafull29[[83573 ;; 83579, 9]] = 1.54 * 10^6;
        datafull29[[83573 ;; 83579, 10]] = 67;
        datafull29[[83573 ;; 83579, 11]] = 4.0 * 10^7;
        datafull29[[83573 ;; 83579, 12]] = 2.7 * 10^9;
        datafull29[[83573 ;; 83579, 14]] = 30;
```

```
In[•]:= datafull30 = manipulator2[datafull29, 972];

In[•]:= (* weight corrections *)
datafull30[[105 577 ;; 105 584, 11]] = 2.24 * 10^9;
datafull30[[105 636 ;; 105 642, 11]] = 2.63 * 10^9;
datafull30[[105 658 ;; 105 691, 11]] = 2.25 * 10^9;
datafull30[[105 728 ;; 105 735, 11]] = 1.83 * 10^9;
datafull30[[105 809 ;; 105 817, 11]] = 1.50 * 10^9;
datafull30[[105 902 ;; 105 915, 11]] = 1.82 * 10^9;

In[•]:= (* width, thickness, weight,length corrections *)
datafull30[[252 504 ;; 252 511, 9]] = 1.21 * 10^6;
datafull30[[252 504 ;; 252 511, 10]] = 67;
datafull30[[252 504 ;; 252 511, 11]] = 1.96 * 10^9;
datafull30[[252 504 ;; 252 511, 12]] = 3.20 * 10^9;

datafull30[[105 792 ;; 105 799, 11]] = 1.96 * 10^9;

In[•]:= datafull31 = manipulator2[datafull30, 1165];

In[•]:= (* weight corrections *)
datafull31[[116 114 ;; 116 120, 11]] = 2.5 * 10^9;
datafull31[[116 212 ;; 116 218, 11]] = 1.72 * 10^9;
datafull31[[116 289 ;; 116 302, 11]] = 1.71 * 10^9;
datafull31[[116 317 ;; 116 323, 11]] = 1.83 * 10^9;
datafull31[[116 382 ;; 116 386, 11]] = 4.51 * 10^9;
datafull31[[116 407 ;; 116 410, 11]] = 2.5 * 10^9;
datafull31[[116 452 ;; 116 458, 11]] = 2.05 * 10^9;
datafull31[[116 492 ;; 116 498, 11]] = 2.07 * 10^9;

In[•]:= (* width, thickness, weight, length, st.gr. corrections *)
datafull31[[116 336 ;; 116 339, 9]] = 1.74 * 10^6;
datafull31[[116 336 ;; 116 339, 10]] = 66;
datafull31[[116 336 ;; 116 339, 11]] = 2.5 * 10^9;
datafull31[[116 336 ;; 116 339, 12]] = 2.86 * 10^9;
datafull31[[116 336 ;; 116 339, 14]] = 41;

In[•]:= datafull32 = manipulator2[datafull31, 1203];
```

```
In[ ]:= (* weight corrections *)
datafull32[[120293 ;; 120298, 11]] = 2.18 * 10^9;
datafull32[[120311 ;; 120316, 11]] = 2.19 * 10^9;
datafull32[[120330 ;; 120336, 11]] = 0.5 * 10^9;
datafull32[[120343 ;; 120348, 11]] = 2.19 * 10^9;
datafull32[[120367 ;; 120372, 11]] = 2.19 * 10^9;
datafull32[[120386 ;; 120392, 11]] = 2.19 * 10^9;
datafull32[[120442 ;; 120448, 11]] = 0.5 * 10^9;
datafull32[[120636 ;; 120699, 11]] = 2.18 * 10^9;
datafull32[[120726 ;; 120791, 11]] = 2.18 * 10^9;
datafull32[[120869 ;; 120927, 11]] = 2.18 * 10^9;
datafull32[[120984 ;; 120990, 11]] = 2.19 * 10^9;
datafull32[[121005 ;; 121018, 11]] = 2.17 * 10^9;
datafull32[[121039 ;; 121045, 11]] = 2.18 * 10^9;
datafull32[[121287 ;; 121292, 11]] = 2.26 * 10^9;
datafull32[[121311 ;; 121316, 11]] = 1.59 * 10^9;
datafull32[[121619 ;; 121625, 11]] = 2.17 * 10^9;
datafull32[[121640 ;; 121646, 11]] = 1.86 * 10^9;

In[ ]:= datafull33 = manipulator2[datafull32, 1279];

In[ ]:= (* weight corrections *)
datafull33[[128141 ;; 128147, 11]] = 1.56 * 10^9;
datafull33[[128201 ;; 128207, 11]] = 1.92 * 10^9;
datafull33[[128240 ;; 128245, 11]] = 2.17 * 10^9;
datafull33[[128275 ;; 128279, 11]] = 3.12 * 10^9;
datafull33[[128326 ;; 128329, 11]] = 3.06 * 10^9;
datafull33[[128347 ;; 128351, 11]] = 3.06 * 10^9;
datafull33[[128392 ;; 128396, 11]] = 3.07 * 10^9;
datafull33[[128446 ;; 128450, 11]] = 3.12 * 10^9;
datafull33[[128500 ;; 128504, 11]] = 3.12 * 10^9;
datafull33[[128519 ;; 128536, 11]] = 3.12 * 10^9;
datafull33[[128562 ;; 128596, 11]] = 3.06 * 10^9;

In[ ]:= (* length corrections *)
datafull33[[128338 ;; 128341, 12]] = 3.8 * 10^9;
datafull33[[128831 ;; 128838, 12]] = 2.04 * 10^9;

In[ ]:= (* width, thickness, weight, length, st.gr. corrections *)
datafull31[[128808 ;; 128815, 9]] = 1.28 * 10^6;
datafull31[[128808 ;; 128815, 10]] = 66;
datafull31[[128808 ;; 128815, 11]] = 1.0 * 10^7;
datafull31[[128808 ;; 128815, 12]] = 1.57 * 10^7;
datafull31[[128808 ;; 128815, 14]] = 30;

In[ ]:= datafull34 = manipulator2[datafull33, 1347];

In[ ]:= (* length corrections *)
datafull34[[157142 ;; 157148, 12]] = 1.7 * 10^9;
```

```
In[ ]:= (* width corrections *)
datafull34[[157419 ;; 157425, 9]] = 1.86 * 10^6;

In[ ]:= (* weight corrections *)
datafull34[[157482 ;; 157488, 11]] = 3.0 * 10^9;
datafull34[[157603 ;; 157609, 11]] = 2.12 * 10^9;
datafull34[[157659 ;; 157665, 11]] = 2.12 * 10^9;
datafull34[[157721 ;; 157724, 11]] = 3.75 * 10^9;
datafull34[[157875 ;; 157879, 11]] = 3.0 * 10^9;
datafull34[[158043 ;; 158044, 11]] = 2.04 * 10^9;

In[ ]:= datafull35 = manipulator2[datafull34, 1584];

In[ ]:= (* weight corrections *)
datafull35[[243134 ;; 243140, 11]] = 2.16 * 10^9;
datafull35[[243226 ;; 243232, 11]] = 4.5 * 10^9;
datafull35[[243336 ;; 243341, 11]] = 4.0 * 10^9;
datafull35[[243728 ;; 243731, 11]] = 3.65 * 10^9;
datafull35[[243823 ;; 243829, 11]] = 2.5 * 10^9;
datafull35[[243852 ;; 243855, 11]] = 3.65 * 10^9;
datafull35[[243896 ;; 243903, 11]] = 2.0 * 10^9;
datafull35[[243961 ;; 243966, 11]] = 1.91 * 10^9;
datafull35[[244174 ;; 244178, 11]] = 3.1 * 10^9;

In[ ]:= (* length corrections *)
datafull35[[243261 ;; 243266, 12]] = 2.32 * 10^9;
datafull35[[243668 ;; 243688, 12]] = 2.81 * 10^9;
datafull35[[243768 ;; 243795, 12]] = 2.81 * 10^9;
datafull35[[243830 ;; 243836, 12]] = 2.72 * 10^9;
datafull35[[243837 ;; 243843, 12]] = 2.81 * 10^9;

In[ ]:= (* width, thickness, length, st.gr. corrections *)
datafull35[[243541 ;; 243546, 9]] = 1.85 * 10^6;
datafull35[[243541 ;; 243546, 10]] = 65;
datafull35[[243541 ;; 243546, 12]] = 4.62 * 10^8;
datafull35[[243541 ;; 243546, 14]] = 30;

In[ ]:= (* width, thickness, length, st.gr. corrections *)
datafull35[[244184, 9]] = 1.43 * 10^6;
datafull35[[244184, 10]] = 65;
datafull35[[244184, 12]] = 1.42 * 10^10;
datafull35[[244184, 14]] = 31;

In[ ]:= (* width, thickness, weight, length, st.gr. corrections *)
datafull35[[244186 ;; 244190, 9]] = 1.43 * 10^6;
datafull35[[244186 ;; 244190, 10]] = 65;
datafull35[[244186 ;; 244190, 11]] = 3.10 * 10^9;
datafull35[[244186 ;; 244190, 12]] = 4.39 * 10^9;
datafull35[[244186 ;; 244190, 14]] = 31;
```

```
In[•]:= (* width corrections *)
        datafull35[[243635 ;; 243640, 9]] = 1.78 * 10^6;

In[•]:= datafull36 = manipulator2[datafull35, 2289];

In[•]:= (* weight corrections *)
        datafull36[[253466 ;; 253472, 11]] = 1.65 * 10^9;
        datafull36[[253596 ;; 253602, 11]] = 3.01 * 10^9;
        datafull36[[253821 ;; 253833, 11]] = 2.09 * 10^9;
        datafull36[[253834 ;; 253839, 11]] = 2.5 * 10^9;
        datafull36[[254024 ;; 254029, 11]] = 2.13 * 10^9;
        datafull36[[254310 ;; 254316, 11]] = 0.5 * 10^9;

In[•]:= (* width, thickness, length, st.gr. corrections *)
        datafull36[[254113, 9]] = 1.22 * 10^6;
        datafull36[[254113, 10]] = 65;
        datafull36[[254113, 12]] = 1.73 * 10^10;
        datafull36[[254113, 14]] = 26;

In[•]:= (* width, thickness, length corrections *)
        datafull36[[254373 ;; 254380, 9]] = 1.23 * 10^6;
        datafull36[[254373 ;; 254380, 10]] = 65;
        datafull36[[254373 ;; 254380, 12]] = 4.93 * 10^7;

In[•]:= (* width corrections *)
        datafull36[[254303 ;; 254309, 9]] = 1.23 * 10^6;

In[•]:= datafull37 = manipulator2[datafull36, 2403];

In[•]:= (* width and weight corrections *)
        datafull37[[261200 ;; 261204, 9]] = 1.25 * 10^6;
        datafull37[[261200 ;; 261204, 11]] = 2.13 * 10^9;
        datafull37[[261775 ;; 261802, 9]] = 0.957 * 10^6;
        datafull37[[261803 ;; 261810, 11]] = 2.5 * 10^9;
        datafull37[[261811 ;; 261818, 9]] = 0.957 * 10^6;

In[•]:= (* length corrections *)
        datafull37[[261537 ;; 261543, 12]] = 3.29 * 10^9;

In[•]:= (* weight corrections *)
        datafull37[[261544 ;; 261550, 11]] = 2.0 * 10^9;

In[•]:= datafull38 = manipulator2[datafull37, 2446];
```

```
In[•]:= (* width, thickness, weight, length, st.gr. corrections *)
        datafull38[[275873 ;; 275877, 9]] = 1.64 * 10^6;
        datafull38[[275873 ;; 275877, 10]] = 66;
        datafull38[[275873 ;; 275877, 11]] = 4.0 * 10^9;
        datafull38[[275873 ;; 275877, 12]] = 4.99 * 10^9;
        datafull38[[275873 ;; 275877, 14]] = 31;

        datafull38[[275880 ;; 275884, 9]] = 1.64 * 10^6;
        datafull38[[275880 ;; 275884, 10]] = 66;
        datafull38[[275880 ;; 275884, 11]] = 4.0 * 10^9;
        datafull38[[275880 ;; 275884, 12]] = 4.99 * 10^9;
        datafull38[[275880 ;; 275884, 14]] = 31;

        datafull38[[275890 ;; 275894, 11]] = 4.0 * 10^9;

In[•]:= datafull39 = manipulator2[datafull38, 2585];

In[•]:= (* width, thickness, length, st.gr. corrections *)
        datafull39[[283081 ;; 283086, 9]] = 1.85 * 10^6;
        datafull39[[283081 ;; 283086, 10]] = 65;
        datafull39[[283081 ;; 283086, 12]] = 3.08 * 10^8;
        datafull39[[283081 ;; 283086, 14]] = 30;

In[•]:= datafull40 = manipulator2[datafull39, 2646];

In[•]:= (* width, thickness, length, st.gr. corrections *)
        datafull40[[299776 ;; 299780, 9]] = 1.87 * 10^6;
        datafull40[[299776 ;; 299780, 10]] = 78;
        datafull40[[299776 ;; 299780, 12]] = 9.17 * 10^8;
        datafull40[[299776 ;; 299780, 14]] = 71;

In[•]:= datafull41 = manipulator2[datafull40, 2853];

In[•]:= (* width corrections *)
        datafull41[[50650 ;; 50655, 9]] = 1.85 * 10^6;
        datafull41[[50662 ;; 50667, 9]] = 1.85 * 10^6;

In[•]:= (* weight corrections *)
        datafull41[[50945 ;; 50951, 11]] = 0.5 * 10^9;

In[•]:= datafull42 = manipulator2[datafull41, 714];

In[•]:= (* width, thickness, length corrections *)
        datafull42[[16743 ;; 16748, 9]] = 1.54 * 10^11;
        datafull42[[16743 ;; 16745, 10]] = 6.5 * 10^9;
        datafull42[[16743 ;; 16745, 12]] = 21000;
```

```
(* width, thickness, weight, length corrections *)
datafull42[[16763 ;; 16767, 9]] = 1.54 * 10^6;
datafull42[[16763 ;; 16767, 10]] = 65;
datafull42[[16763 ;; 16767, 11]] = 0.147 * 10^9;
datafull42[[16763 ;; 16767, 12]] = 1.926 * 10^8;

datafull42[[16940 ;; 16945, 11]] = 4.47 * 10^7;
datafull42[[17031 ;; 17037, 11]] = 5.47 * 10^7;
datafull42[[17129 ;; 17135, 11]] = 1.55 * 10^8;
```

```
datafull43 = manipulator2[datafull42, 398];
```

```
(* Export["ccm1_data_modified_numbered_slx.mx",datafull43] *)
```

```
3.0 * 10^7 / (1.43 * 10^6 * 65 * 7.5755 * 10^(-9))
```

Out[]= 4.2605×10^{7}

```
0.147 * 10^9 / (2.03 * 10^9) * 2.66 * 10^9
```

Out[]= 1.92621×10^{8}

```
2.8 * 10^8 / (2.38 * 10^9) * 2.62 * 10^9
```

Out[]= 3.08235×10^{8}

```
filtercon = Select[datafull25, #[[2]] == 793 &];
part = Join[filtercon[[All, 1 ;; 2]], filtercon[[All, 9 ;; 14]], 2]
```

below rows could not be reasoned with a logical density relation, so they were eliminated.

```
NApos = Complement[Position[datafull[[All, 10]], 0], Position[datafull[[All, 9]], 0]]
```

Out[]= {{252553}, {252554}, {252555}, {252556}, {252557}, {252558}, {252559}, {252560}, {420845}, {420846}, {420847}, {420848}, {420849}, {420850}, {420851}, {420852}}

```
NApos2 = Partition[{385278, 385287, 385288, 385289, 385306, 386693, 386707}, 1];
```

```
NApos3 = Partition[Flatten@{379146, Range[379211, 379215], 447783}, 1];
```

```
datafull[[All, 9]] = ReplacePart[datafull[[All, 9]], {NApos → "NA"}];
datafull[[All, 10]] = ReplacePart[datafull[[All, 10]], {NApos → "NA"}];
datafull[[All, 11]] = ReplacePart[datafull[[All, 11]], {NApos → "NA"}];
datafull[[All, 12]] = ReplacePart[datafull[[All, 12]], {NApos → "NA"}];
```

```
datafull[[All, 9]] = ReplacePart[datafull[[All, 9]], {NApos2 → "NA"}];
datafull[[All, 10]] = ReplacePart[datafull[[All, 10]], {NApos2 → "NA"}];
datafull[[All, 11]] = ReplacePart[datafull[[All, 11]], {NApos2 → "NA"}];
datafull[[All, 12]] = ReplacePart[datafull[[All, 12]], {NApos2 → "NA"}];
```

```
datafull[[All, 9]] = ReplacePart[datafull[[All, 9]], {NApos3 → "NA"}];
datafull[[All, 10]] = ReplacePart[datafull[[All, 10]], {NApos3 → "NA"}];
datafull[[All, 11]] = ReplacePart[datafull[[All, 11]], {NApos3 → "NA"}];
datafull[[All, 12]] = ReplacePart[datafull[[All, 12]], {NApos3 → "NA"}];
```

below rows were reasoned with a logical density relation, so they were manipulated.

```
In[•]:= manupos1 = Complement[Position[datafull[[All, 9]], 0], Position[datafull[[All, 10]], 0]]
Out[•]= {{16 746}, {16 747}, {16 748}}

In[•]:= datafull[[Flatten@manupos1, 11]] *= 1000;
        datafull[[Flatten@manupos1, 12]] *= 10;
        datafull[[Flatten@manupos1, 9]] = 1540;

In[•]:= datafull[[41 218 ;; 41 223, 11]] *= 100;
```

below rows were reasoned with a logical density relation in couple of steps, so they were manipulated.

```
In[•]:= datafull[[92 119 ;; 92 124, 9]] *= 10;
        datafull[[92 119 ;; 92 124, 12]] *= 100;
        datafull[[92 119 ;; 92 124, 11]] = 1.75 * 10^6;

In[•]:= datafull[[362 063 ;; 362 069, 10]] = 67;
        datafull[[362 063 ;; 362 069, 11]] = 1.2 * 10^6;

In[•]:= datafull[[390 449 ;; 390 455, 12]] = 4.22 * 10^6;
        datafull[[362 063 ;; 362 069, 11]] = 2.12 * 10^6;

In[•]:= datafull[[385 231 ;; 385 237, 9]] = 1170;
        datafull[[385 231 ;; 385 237, 10]] = 65;
        datafull[[385 231 ;; 385 237, 12]] = 3.01 * 10^6;
        datafull[[385 231 ;; 385 237, 11]] = 1.735 * 10^6;

In[•]:= datafull[[15 994 ;; 15 999, 11]] = 1.25 * 10^6;

In[•]:= datafull[[16 011 ;; 16 016, 12]] *= 100;
        datafull[[16 011 ;; 16 016, 11]] = 1.5924069890687563`*^6;

In[•]:= (* datafull[[16041;;16046,9]]=1530;
        datafull[[16041;;16046,10]]=67;
        datafull[[16041;;16046,12]]=2.66*10^6;
        datafull[[16041;;16046,11]]=2.06*10^6; *)

In[•]:= datafull[[41 447 ;; 41 452, 12]] *= 100;
        datafull[[41 447 ;; 41 452, 11]] = 1.613922722320007`*^6;

In[•]:= datafull[[53 766 ;; 53 772, 12]] *= 100;
        datafull[[53 766 ;; 53 772, 11]] = 1.7065454545454546`*^6;

In[•]:= datafull[[53 780 ;; 53 786, 12]] *= 100;
        datafull[[53 780 ;; 53 786, 11]] = 1.7065454545454546`*^6;

In[•]:= (* datafull[[53817;;53823,9]]=1840;
        datafull[[53817;;53823,10]]=66;
        datafull[[53817;;53823,12]]=3.42*10^6;
        datafull[[53817;;53823,11]]=3.12*10^6; *)
```

```
In[ ]:= (* datafull[[96239;;96245,9]]=1640;
         datafull[[96239;;96245,10]]=75;
         datafull[[96239;;96245,12]]=2.18*10^6;
         datafull[[96239;;96245,11]]=2.02*10^6; *)

In[ ]:= datafull[[96253 ;; 96259, 12]] *= 100;
         datafull[[96253 ;; 96259, 11]] = 1.6180404040404044`*^6;

In[ ]:= datafull[[104711 ;; 104713, 12]] *= 100;
         datafull[[104711 ;; 104713, 11]] = 2.769490581796426`*^6;

In[ ]:= (* datafull[[104759;;104761,9]]=1800;
         datafull[[104759;;104761,10]]=67;
         datafull[[104759;;104761,12]]=4.13*10^6;
         datafull[[104759;;104761,11]]=3.74*10^6; *)

In[ ]:= (* datafull[[118392;;118397,9]]=1260;
         datafull[[118392;;118397,10]]=65;
         datafull[[118392;;118397,12]]=3.39*10^6;
         datafull[[118392;;118397,11]]=2.11*10^6; *)

In[ ]:= datafull[[118532 ;; 118537, 12]] *= 100;
         datafull[[118532 ;; 118537, 11]] = 1.6756944444444445`*^6;

In[ ]:= datafull[[124683 ;; 124689, 12]] *= 100;
         datafull[[124683 ;; 124689, 11]] = 1.6510713411863402`*^6;
         datafull[[124852 ;; 124858, 12]] *= 100;
         datafull[[124852 ;; 124858, 11]] = 1.703728381900024`*^6;

In[ ]:= datafull[[125360 ;; 125365, 12]] *= 100;
         datafull[[125360 ;; 125365, 11]] = 1.625953145177113`*^6;

In[ ]:= datafull[[156289 ;; 156290, 12]] *= 100;
         datafull[[156289 ;; 156290, 11]] = 2.9909317508779913`*^6;

In[ ]:= datafull[[283558 ;; 283562, 12]] *= 100;
         datafull[[283558 ;; 283562, 11]] = 1.9209259259259258`*^6;

In[ ]:= datafull[[356875 ;; 356879, 12]] *= 100;
         datafull[[356875 ;; 356879, 11]] = 1.5067064676616918`*^6;

In[ ]:= datafull[[379216 ;; 379222, 12]] *= 100;
         datafull[[379216 ;; 379222, 11]] = 1.7567839463925583`*^6;

In[ ]:= datafull[[381392 ;; 381397, 12]] *= 100;
         datafull[[381392 ;; 381397, 11]] = 1.3600207741089002`*^6;

In[ ]:= datafull[[383153 ;; 383158, 12]] *= 100;
         datafull[[383153 ;; 383158, 11]] = 1.3297843665768192`*^6;
         datafull[[383240 ;; 383245, 12]] *= 100;
         datafull[[383240 ;; 383245, 11]] = 1.46`*^7;
```

```
In[ ]:= datafull[[386577 ;; 386580, 12]] *= 100;
        datafull[[386577 ;; 386580, 11]] = 1.6326604681510483`*^6;
        datafull[[386581, 12]] *= 100;
        datafull[[386581, 11]] = 1.6326604681510483`*^6;

In[ ]:= datafull[[143475 ;; 143480, 11]] = 2.893228651087832`*^6;

In[ ]:= datafull[[158486 ;; 158491, 11]] = 3.324187608806964`*^6;

In[ ]:= datafull[[198873 ;; 198879, 11]] = 3.485975450930675`*^6;

In[ ]:= datafull[[243108 ;; 243112, 11]] = 3.860784156121903`*^6;

In[ ]:= datafull[[252526 ;; 252532, 11]] = 2.8167605744860605`*^6;

In[ ]:= datafull[[345143 ;; 345148, 11]] = 2.3077998947620187`*^6;

In[ ]:= datafull[[375491 ;; 375497, 11]] = 2.4211330049261083`*^6;

In[ ]:= datafull[[390449 ;; 390455, 12]] = 4.22 * 10^6;
        datafull[[390449 ;; 390455, 11]] = 2.12`*^6;

        filt = Select[datafull, #[[13]] == 17172021 &];
        N@filt[[All, 11]] / (filt[[All, 9]] * filt[[All, 10]] * filt[[All, 12]]);

In[ ]:= zeropatterns =
         Table[SequenceCases[datafull[[i, 9 ;; 12]], {0, 0, _, 0}], {i, Length@datafull}]

Out[ ]= {{}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {},
         {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, ··· 459143 ···, {}, {},
         {{0, 0, 7.24×10^6, 0}}, {{0, 0, 7.24×10^6, 0}}, {{0, 0, 7.24×10^6, 0}},
         {{0, 0, 7.24×10^6, 0}}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {},
         {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {{0, 0, 0, 0}}, {{0, 0, 0, 0}}}

large output | show less | show more | show all | set size limit...

In[ ]:= Table[Length@Position[datafull[[All, i]], 0], {i, {9, 10, 11, 12}}]

Out[ ]= {61324, 61324, 10481, 61324}

In[ ]:= Length@Flatten[zeropatterns, 1]
        Length@Position[zeropatterns, {{0, 0, 0, 0}}]
        Length@Position[zeropatterns, {{0, 0, Except@0, 0}}]

Out[ ]= 61324

Out[ ]= 10481

Out[ ]= 50843

In[ ]:= Table[Length@Position[datafull[[All, i]], "NA"], {i, {9, 10, 11, 12}}]

Out[ ]= {1434, 1434, 1434, 1434}
```

In[•]:=
```
datafull[[Flatten@Position[zeropatterns, {{0, 0, Except@0, 0}}], 11]]
```

Out[•]=
```
{635 000., 635 000., 635 000., 635 000., 65 300., 65 300., 65 300., 65 300.,
 65 300., 65 300., 65 300., 82., 82., 82., 82., 82., 82., ··· 50 810 ···, 180 000.,
 180 000., 180 000., 180 000., 180 000., 180 000., 140 000., 140 000., 140 000.,
 140 000., 140 000., 140 000., 7.24 × 10^6, 7.24 × 10^6, 7.24 × 10^6, 7.24 × 10^6}
```

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In[•]:=
```
datafull[[Flatten@Position[zeropatterns, {{0, 0, Except@0, 0}}], 13]]
```

Out[•]=
```
{17 001 221, 17 001 221, 17 001 221, 17 001 221, 17 000 401, 17 000 401, 17 000 401, 17 000 401,
 17 000 401, 17 000 401, 17 000 401, 17 000 421, 17 000 421, 17 000 421, 17 000 421, ··· 50 813 ···,
 18 024 061, 18 024 061, 18 024 061, 18 024 061, 18 024 061, 18 024 161, 18 024 161, 18 024 161,
 18 024 161, 18 024 161, 18 024 161, 18 024 141, 18 024 141, 18 024 141, 18 024 141}
```

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In[•]:=
```
2.07 * 10^6 / (1520 * 66 * 2.73 * 10^6)
```

Out[•]=
$$7.55823 \times 10^{-6}$$

In[•]:=
```
Select[Select[datafull[[All, 11]], # != 0 &], # != "NA" &]
```

Out[•]=
```
{2.74 × 10^6, 2.74 × 10^6, 2.74 × 10^6, 2.74 × 10^6, 2.74 × 10^6, 2.74 × 10^6,
 2.74 × 10^6, 1.97 × 10^6, 1.97 × 10^6, 1.97 × 10^6, 1.97 × 10^6, 1.97 × 10^6,
 1.97 × 10^6, 1.97 × 10^6, 2.07 × 10^6, ··· 447 258 ···, 2.05 × 10^6, 2.05 × 10^6,
 2.05 × 10^6, 2.05 × 10^6, 2.05 × 10^6, 2.05 × 10^6, 2.05 × 10^6, 2.05 × 10^6, 2.05 × 10^6,
 2.05 × 10^6, 2.05 × 10^6, 2.14 × 10^6, 2.14 × 10^6, 2.14 × 10^6, 2.14 × 10^6}
```

large output | show less | show more | show all | set size limit...

In[ ]:=
```
Histogram[%125, PlotRange → All, ScalingFunctions → "Log"]
```

Out[ ]=