Data Collection

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1 Video Details and Snippet

```
curl \
  'https://youtube.googleapis.com/youtube/v3/videos?part=contentDetails%2Csnippet&id=y7zR
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
curl \
  'https://youtube.googleapis.com/youtube/v3/videos?part=contentDetails%2Csnippet&id=IYSI
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```r
video_information <- read_csv(file = "datasets/video_information.csv",
                             show_col_types = FALSE)
video_position <- video_information %>%
  select(id, position)
video_type <- video_information %>%
  select(id, talking_head)
```

id	title	description
y7zRv0bPAt4	Bidang Koordinat	Video ini menjelaskan konsep-
8_HqAYKZZ_I	Rumus Jarak	Video ini diawali dengan ekspl
errB7Ku0HyQ	Rumus Titik Tengah	Video ini diawali dengan ekspl
L60C_wcLDHU	Grafik dan Plot Titik	Video ini menjelaskan definisi
Jv4y4Z4zeRc	Titik Potong Grafik dengan Sumbu-Sumbu Koordinat	Video ini menjelaskan cara me
7Ak8vzFzN_Y	Persamaan Lingkaran	Apa #persamaan dari suatu li

2 Audience Retention

2.1 Equations and Graphs

2.1.1 2020

Retrieving audience retention data of videos from subtopic 1.1 Bidang Koordinat. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
 1 y7zRv0bPAt4              0.01                 1.05                      0.755
 2 y7zRv0bPAt4              0.02                 0.897                     0.842
 3 y7zRv0bPAt4              0.03                 0.850                     0.893
 4 y7zRv0bPAt4              0.04                 0.776                     0.902
 5 y7zRv0bPAt4              0.05                 0.757                     0.902
 6 y7zRv0bPAt4              0.06                 0.748                     0.903
 7 y7zRv0bPAt4              0.07                 0.785                     0.906
 8 y7zRv0bPAt4              0.08                 0.794                     0.908
 9 y7zRv0bPAt4              0.09                 0.785                     0.907
10 y7zRv0bPAt4              0.1                  0.785                     0.900
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.2 Grafik Persamaan Dua Variabel. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
 1 L60C_wcLDHU              0.01                 1.07                      0.743
 2 L60C_wcLDHU              0.02                 0.936                     0.835
 3 L60C_wcLDHU              0.03                 0.882                     0.899
 4 L60C_wcLDHU              0.04                 0.891                     0.924
```

```
 5 L60C_wcLDHU              0.05              0.918              0.934
 6 L60C_wcLDHU              0.06              0.891              0.937
 7 L60C_wcLDHU              0.07              0.918              0.938
 8 L60C_wcLDHU              0.08              0.954              0.938
 9 L60C_wcLDHU              0.09              0.946              0.939
10 L60C_wcLDHU              0.1               0.991              0.938
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.3 Garis. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 qxsXKYJRgJI               0.01                 1.01                     0.544
 2 qxsXKYJRgJI               0.02                 0.973                    0.684
 3 qxsXKYJRgJI               0.03                 0.919                    0.804
 4 qxsXKYJRgJI               0.04                 0.973                    0.869
 5 qxsXKYJRgJI               0.05                 0.986                    0.898
 6 qxsXKYJRgJI               0.06                 1.03                     0.905
 7 qxsXKYJRgJI               0.07                 0.986                    0.900
 8 qxsXKYJRgJI               0.08                 0.919                    0.886
 9 qxsXKYJRgJI               0.09                 0.905                    0.866
10 qxsXKYJRgJI               0.1                  0.811                    0.845
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.4 Persamaan Kuadrat. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 2Wsb2KmeD04               0.01                 1.03                     0.658
```

```
 2 2Wsb2KmeD04                 0.02           0.870                   0.722
 3 2Wsb2KmeD04                 0.03           0.857                   0.759
 4 2Wsb2KmeD04                 0.04           0.831                   0.771
 5 2Wsb2KmeD04                 0.05           0.766                   0.791
 6 2Wsb2KmeD04                 0.06           0.727                   0.825
 7 2Wsb2KmeD04                 0.07           0.805                   0.865
 8 2Wsb2KmeD04                 0.08           0.753                   0.900
 9 2Wsb2KmeD04                 0.09           0.766                   0.921
10 2Wsb2KmeD04                 0.1            0.831                   0.930
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.5 Persamaan-Persamaan Lain. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTimeR
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 DRr8kXo0Agg               0.01                 1.02                     0.723
 2 DRr8kXo0Agg               0.02                 0.779                    0.805
 3 DRr8kXo0Agg               0.03                 0.712                    0.861
 4 DRr8kXo0Agg               0.04                 0.692                    0.883
 5 DRr8kXo0Agg               0.05                 0.692                    0.893
 6 DRr8kXo0Agg               0.06                 0.692                    0.898
 7 DRr8kXo0Agg               0.07                 0.596                    0.902
 8 DRr8kXo0Agg               0.08                 0.654                    0.907
 9 DRr8kXo0Agg               0.09                 0.654                    0.915
10 DRr8kXo0Agg               0.1                  0.625                    0.926
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.6 Pertidaksamaan. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTimeR
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id     elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
 1 RF1chK7xiX0              0.01                1.14                      0.783
 2 RF1chK7xiX0              0.02                0.925                     0.868
 3 RF1chK7xiX0              0.03                0.825                     0.917
 4 RF1chK7xiX0              0.04                0.812                     0.926
 5 RF1chK7xiX0              0.05                0.838                     0.928
 6 RF1chK7xiX0              0.06                0.825                     0.931
 7 RF1chK7xiX0              0.07                0.838                     0.933
 8 RF1chK7xiX0              0.08                0.838                     0.932
 9 RF1chK7xiX0              0.09                0.825                     0.926
10 RF1chK7xiX0              0.1                 0.788                     0.917
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.7 Persamaan dan Pertidak-samaan Nilai Mutlak. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id     elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
 1 uDQAWZsh3ns             0.01                0.970                     0.526
 2 uDQAWZsh3ns             0.02                0.851                     0.640
 3 uDQAWZsh3ns             0.03                0.791                     0.729
 4 uDQAWZsh3ns             0.04                0.821                     0.775
 5 uDQAWZsh3ns             0.05                0.806                     0.805
 6 uDQAWZsh3ns             0.06                0.836                     0.831
 7 uDQAWZsh3ns             0.07                0.881                     0.852
 8 uDQAWZsh3ns             0.08                0.821                     0.870
 9 uDQAWZsh3ns             0.09                0.806                     0.887
10 uDQAWZsh3ns             0.1                 0.791                     0.903
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.8 Metode Grafik. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 v4NPzGXcbaw               0.01                0.920                     0.668
 2 v4NPzGXcbaw               0.02                0.701                     0.784
 3 v4NPzGXcbaw               0.03                0.724                     0.872
 4 v4NPzGXcbaw               0.04                0.701                     0.913
 5 v4NPzGXcbaw               0.05                0.701                     0.933
 6 v4NPzGXcbaw               0.06                0.690                     0.942
 7 v4NPzGXcbaw               0.07                0.701                     0.945
 8 v4NPzGXcbaw               0.08                0.713                     0.941
 9 v4NPzGXcbaw               0.09                0.690                     0.924
10 v4NPzGXcbaw               0.1                 0.655                     0.887
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopic data into one topic.

```
# A tibble: 2,500 x 5
   vid_id    elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                  <dbl>                <dbl>                   <dbl> <dbl>
 1 y7zRv0b~                0.01                 1.05                   0.755  2020
 2 y7zRv0b~                0.02                 0.897                  0.842  2020
 3 y7zRv0b~                0.03                 0.850                  0.893  2020
 4 y7zRv0b~                0.04                 0.776                  0.902  2020
 5 y7zRv0b~                0.05                 0.757                  0.902  2020
 6 y7zRv0b~                0.06                 0.748                  0.903  2020
 7 y7zRv0b~                0.07                 0.785                  0.906  2020
 8 y7zRv0b~                0.08                 0.794                  0.908  2020
 9 y7zRv0b~                0.09                 0.785                  0.907  2020
10 y7zRv0b~                0.1                  0.785                  0.900  2020
# i 2,490 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.1.2 2021

Retrieving audience retention data of videos from subtopic 1.1 Bidang Koordinat. The
data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
```

```
      <chr>                  <dbl>             <dbl>                       <dbl>
 1 y7zRv0bPAt4               0.01              1.07                        0.771
 2 y7zRv0bPAt4               0.02              0.944                       0.863
 3 y7zRv0bPAt4               0.03              0.864                       0.923
 4 y7zRv0bPAt4               0.04              0.848                       0.943
 5 y7zRv0bPAt4               0.05              0.856                       0.948
 6 y7zRv0bPAt4               0.06              0.928                       0.95
 7 y7zRv0bPAt4               0.07              0.944                       0.950
 8 y7zRv0bPAt4               0.08              0.928                       0.950
 9 y7zRv0bPAt4               0.09              0.912                       0.950
10 y7zRv0bPAt4               0.1               0.896                       0.950
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.2 Grafik Persamaan Dua Variabel. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTim
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id        elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                  <dbl>             <dbl>                       <dbl>
 1 L60C_wcLDHU               0.01              0.993                       0.732
 2 L60C_wcLDHU               0.02              0.903                       0.832
 3 L60C_wcLDHU               0.03              0.848                       0.902
 4 L60C_wcLDHU               0.04              0.869                       0.926
 5 L60C_wcLDHU               0.05              0.834                       0.932
 6 L60C_wcLDHU               0.06              0.834                       0.936
 7 L60C_wcLDHU               0.07              0.862                       0.938
 8 L60C_wcLDHU               0.08              0.897                       0.941
 9 L60C_wcLDHU               0.09              0.917                       0.944
10 L60C_wcLDHU               0.1               0.952                       0.947
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.3 Garis. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTim
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 qxsXKYJRgJI                0.01                1.03                      0.711
 2 qxsXKYJRgJI                0.02                0.917                     0.790
 3 qxsXKYJRgJI                0.03                0.890                     0.845
 4 qxsXKYJRgJI                0.04                0.816                     0.867
 5 qxsXKYJRgJI                0.05                0.853                     0.877
 6 qxsXKYJRgJI                0.06                0.853                     0.884
 7 qxsXKYJRgJI                0.07                0.771                     0.888
 8 qxsXKYJRgJI                0.08                0.752                     0.892
 9 qxsXKYJRgJI                0.09                0.762                     0.896
10 qxsXKYJRgJI                0.1                 0.752                     0.901
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.4 Persamaan Kuadrat. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 2Wsb2KmeD04                0.01                1.05                      0.734
 2 2Wsb2KmeD04                0.02                0.979                     0.832
 3 2Wsb2KmeD04                0.03                0.928                     0.900
 4 2Wsb2KmeD04                0.04                0.948                     0.928
 5 2Wsb2KmeD04                0.05                0.990                     0.941
 6 2Wsb2KmeD04                0.06                0.938                     0.948
 7 2Wsb2KmeD04                0.07                0.897                     0.950
 8 2Wsb2KmeD04                0.08                0.969                     0.950
 9 2Wsb2KmeD04                0.09                0.969                     0.950
10 2Wsb2KmeD04                0.1                 1.08                      0.950
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.5 Persamaan-Persamaan Lain. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id        elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                      <dbl>                <dbl>                     <dbl>
 1 DRr8kXo0Agg                 0.01                 1.08                     0.793
 2 DRr8kXo0Agg                 0.02                 0.870                    0.882
 3 DRr8kXo0Agg                 0.03                 0.861                    0.937
 4 DRr8kXo0Agg                 0.04                 0.844                    0.949
 5 DRr8kXo0Agg                 0.05                 0.8                      0.950
 6 DRr8kXo0Agg                 0.06                 0.8                      0.950
 7 DRr8kXo0Agg                 0.07                 0.756                    0.950
 8 DRr8kXo0Agg                 0.08                 0.8                      0.950
 9 DRr8kXo0Agg                 0.09                 0.756                    0.950
10 DRr8kXo0Agg                 0.1                  0.765                    0.950
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.6 Pertidaksamaan. The data
was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id        elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                      <dbl>                <dbl>                     <dbl>
 1 RF1chK7xiX0                 0.01                 0.94                     0.656
 2 RF1chK7xiX0                 0.02                 0.73                     0.780
 3 RF1chK7xiX0                 0.03                 0.72                     0.879
 4 RF1chK7xiX0                 0.04                 0.77                     0.926
 5 RF1chK7xiX0                 0.05                 0.8                      0.944
 6 RF1chK7xiX0                 0.06                 0.84                     0.950
 7 RF1chK7xiX0                 0.07                 0.8                      0.950
 8 RF1chK7xiX0                 0.08                 0.78                     0.950
 9 RF1chK7xiX0                 0.09                 0.78                     0.950
10 RF1chK7xiX0                 0.1                  0.77                     0.948
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.7 Persamaan dan Pertidak-
samaan Nilai Mutlak. The data was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 uDQAWZsh3ns               0.01                1.01                      0.729
 2 uDQAWZsh3ns               0.02                0.912                     0.829
 3 uDQAWZsh3ns               0.03                0.875                     0.897
 4 uDQAWZsh3ns               0.04                0.862                     0.922
 5 uDQAWZsh3ns               0.05                0.812                     0.930
 6 uDQAWZsh3ns               0.06                0.85                      0.931
 7 uDQAWZsh3ns               0.07                0.825                     0.931
 8 uDQAWZsh3ns               0.08                0.85                      0.930
 9 uDQAWZsh3ns               0.09                0.788                     0.929
10 uDQAWZsh3ns               0.1                 0.838                     0.927
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 1.8 Metode Grafik. The data
was retrieved on 8 January 2024.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 v4NPzGXcbaw               0.01                1.02                      0.648
 2 v4NPzGXcbaw               0.02                0.631                     0.716
 3 v4NPzGXcbaw               0.03                0.623                     0.773
 4 v4NPzGXcbaw               0.04                0.590                     0.813
 5 v4NPzGXcbaw               0.05                0.648                     0.844
 6 v4NPzGXcbaw               0.06                0.623                     0.863
 7 v4NPzGXcbaw               0.07                0.607                     0.870
 8 v4NPzGXcbaw               0.08                0.623                     0.867
 9 v4NPzGXcbaw               0.09                0.623                     0.860
10 v4NPzGXcbaw               0.1                 0.549                     0.857
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopic data into one topic.

```
# A tibble: 2,500 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                 <dbl>                <dbl>                  <dbl> <dbl>
 1 y7zRv0b~               0.01                1.07                   0.771  2021
 2 y7zRv0b~               0.02                0.944                  0.863  2021
```

```
 3 y7zRv0b~                   0.03                   0.864                   0.923  2021
 4 y7zRv0b~                   0.04                   0.848                   0.943  2021
 5 y7zRv0b~                   0.05                   0.856                   0.948  2021
 6 y7zRv0b~                   0.06                   0.928                   0.95   2021
 7 y7zRv0b~                   0.07                   0.944                   0.950  2021
 8 y7zRv0b~                   0.08                   0.928                   0.950  2021
 9 y7zRv0b~                   0.09                   0.912                   0.950  2021
10 y7zRv0b~                   0.1                    0.896                   0.950  2021
# i 2,490 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.1.3 Two Year Data

```r
retention_1 <- bind_rows(retention_2020_1,
                         retention_2021_1)

write_csv(retention_1,
          file = "datasets/retention_1.csv")

print(retention_1)
```

```
# A tibble: 5,000 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1   year
   <chr>                 <dbl>                <dbl>                  <dbl>  <dbl>
 1 y7zRv0b~               0.01                 1.05                  0.755   2020
 2 y7zRv0b~               0.02                 0.897                 0.842   2020
 3 y7zRv0b~               0.03                 0.850                 0.893   2020
 4 y7zRv0b~               0.04                 0.776                 0.902   2020
 5 y7zRv0b~               0.05                 0.757                 0.902   2020
 6 y7zRv0b~               0.06                 0.748                 0.903   2020
 7 y7zRv0b~               0.07                 0.785                 0.906   2020
 8 y7zRv0b~               0.08                 0.794                 0.908   2020
 9 y7zRv0b~               0.09                 0.785                 0.907   2020
10 y7zRv0b~               0.1                  0.785                 0.900   2020
# i 4,990 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.2 Function

2.2.1 2020

Retrieving audience retention data of videos from subtopic 2.1 Fungsi. The data was
retrieved on 6 January 2024.

```
# A tibble: 400 x 4
   vid_id     elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
```

```
 1 7g35w-sL_JA              0.01              0.991                       0.696
 2 7g35w-sL_JA              0.02              0.894                       0.817
 3 7g35w-sL_JA              0.03              0.832                       0.905
 4 7g35w-sL_JA              0.04              0.858                       0.940
 5 7g35w-sL_JA              0.05              0.832                       0.949
 6 7g35w-sL_JA              0.06              0.858                       0.950
 7 7g35w-sL_JA              0.07              0.823                       0.950
 8 7g35w-sL_JA              0.08              0.832                       0.950
 9 7g35w-sL_JA              0.09              0.796                       0.950
10 7g35w-sL_JA              0.1               0.832                       0.950
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.2 Grafik Fungsi. The data
was retrieved on 7 January 2024.

```
# A tibble: 600 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 aHo1kbccgLM               0.01                1                         0.690
 2 aHo1kbccgLM               0.02                0.9                       0.807
 3 aHo1kbccgLM               0.03                0.8                       0.894
 4 aHo1kbccgLM               0.04                0.854                     0.927
 5 aHo1kbccgLM               0.05                0.836                     0.937
 6 aHo1kbccgLM               0.06                0.864                     0.940
 7 aHo1kbccgLM               0.07                0.818                     0.942
 8 aHo1kbccgLM               0.08                0.782                     0.944
 9 aHo1kbccgLM               0.09                0.773                     0.946
10 aHo1kbccgLM               0.1                 0.754                     0.948
# i 590 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.3 Informasi Penting Grafik
Fungsi. The data was retrieved on 7 January 2024 from Youtube API Explorer with these
codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=elapsedVideoTimeRatio&en
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 MD5LDDmH3Lo               0.01                1.01                      0.770
 2 MD5LDDmH3Lo               0.02                0.840                     0.862
 3 MD5LDDmH3Lo               0.03                0.774                     0.922
```

```
 4 MD5LDDmH3Lo                0.04              0.755                      0.939
 5 MD5LDDmH3Lo                0.05              0.802                      0.943
 6 MD5LDDmH3Lo                0.06              0.783                      0.945
 7 MD5LDDmH3Lo                0.07              0.764                      0.948
 8 MD5LDDmH3Lo                0.08              0.755                      0.949
 9 MD5LDDmH3Lo                0.09              0.736                      0.950
10 MD5LDDmH3Lo                0.1               0.708                      0.950
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.4 Fungsi Linear dan Model-
nya. The data was retrieved on 7 January 2024 from Youtube API Explorer with these
codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id     elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
 1 LIkQgdMtovQ              0.01                0.929                     0.478
 2 LIkQgdMtovQ              0.02                0.788                     0.602
 3 LIkQgdMtovQ              0.03                0.718                     0.712
 4 LIkQgdMtovQ              0.04                0.718                     0.776
 5 LIkQgdMtovQ              0.05                0.706                     0.812
 6 LIkQgdMtovQ              0.06                0.718                     0.841
 7 LIkQgdMtovQ              0.07                0.694                     0.875
 8 LIkQgdMtovQ              0.08                0.718                     0.908
 9 LIkQgdMtovQ              0.09                0.776                     0.928
10 LIkQgdMtovQ              0.1                 0.788                     0.936
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.5 Transformasi Fungsi. The
data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 600 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
```

```
            <chr>              <dbl>               <dbl>                  <dbl>
 1 jytZgg-oQyM               0.01               0.986                  0.643
 2 jytZgg-oQyM               0.02               0.851                  0.763
 3 jytZgg-oQyM               0.03               0.865                  0.856
 4 jytZgg-oQyM               0.04               0.824                  0.902
 5 jytZgg-oQyM               0.05               0.838                  0.923
 6 jytZgg-oQyM               0.06               0.824                  0.933
 7 jytZgg-oQyM               0.07               0.878                  0.932
 8 jytZgg-oQyM               0.08               0.838                  0.922
 9 jytZgg-oQyM               0.09               0.824                  0.903
10 jytZgg-oQyM               0.1                0.824                  0.881
# i 590 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.6 Kombinasi Beberapa
Fungsi. The data was retrieved on 7 January 2024 from Youtube API Explorer with
these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 oKlJDBsc_A0               0.01                 1.01                      0.747
 2 oKlJDBsc_A0               0.02                 0.872                     0.835
 3 oKlJDBsc_A0               0.03                 0.820                     0.893
 4 oKlJDBsc_A0               0.04                 0.808                     0.910
 5 oKlJDBsc_A0               0.05                 0.820                     0.914
 6 oKlJDBsc_A0               0.06                 0.769                     0.914
 7 oKlJDBsc_A0               0.07                 0.731                     0.913
 8 oKlJDBsc_A0               0.08                 0.731                     0.912
 9 oKlJDBsc_A0               0.09                 0.718                     0.909
10 oKlJDBsc_A0               0.1                  0.705                     0.904
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.7 Fungsi Satu-Satu dan
Inversnya. The data was retrieved on 7 January 2024 from Youtube API Explorer with
these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 500 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 hcUC4IFisL4                0.01                0.937                     0.700
 2 hcUC4IFisL4                0.02                0.747                     0.788
 3 hcUC4IFisL4                0.03                0.709                     0.850
 4 hcUC4IFisL4                0.04                0.709                     0.878
 5 hcUC4IFisL4                0.05                0.709                     0.895
 6 hcUC4IFisL4                0.06                0.722                     0.909
 7 hcUC4IFisL4                0.07                0.722                     0.918
 8 hcUC4IFisL4                0.08                0.709                     0.923
 9 hcUC4IFisL4                0.09                0.696                     0.927
10 hcUC4IFisL4                0.1                 0.760                     0.930
# i 490 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopic data into one topic.

```
# A tibble: 3,100 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                 <dbl>                <dbl>                 <dbl> <dbl>
 1 7g35w-s~               0.01                0.991                 0.696  2020
 2 7g35w-s~               0.02                0.894                 0.817  2020
 3 7g35w-s~               0.03                0.832                 0.905  2020
 4 7g35w-s~               0.04                0.858                 0.940  2020
 5 7g35w-s~               0.05                0.832                 0.949  2020
 6 7g35w-s~               0.06                0.858                 0.950  2020
 7 7g35w-s~               0.07                0.823                 0.950  2020
 8 7g35w-s~               0.08                0.832                 0.950  2020
 9 7g35w-s~               0.09                0.796                 0.950  2020
10 7g35w-s~               0.1                 0.832                 0.950  2020
# i 3,090 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.2.2 2021

Retrieving audience retention data of videos from subtopic 2.1 Fungsi with `start_date`
2021-08-22 and `end_date` 2021-12-31. The data was retrieved on 7 January 2024. The code
used for retrieving data from Youtube Analytics and Reporting API were as follows.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 7g35w-sL_JA               0.01                 1.03                     0.721
 2 7g35w-sL_JA               0.02                 0.858                    0.825
 3 7g35w-sL_JA               0.03                 0.850                    0.901
 4 7g35w-sL_JA               0.04                 0.876                    0.933
 5 7g35w-sL_JA               0.05                 0.903                    0.946
 6 7g35w-sL_JA               0.06                 0.903                    0.950
 7 7g35w-sL_JA               0.07                 0.920                    0.950
 8 7g35w-sL_JA               0.08                 0.885                    0.950
 9 7g35w-sL_JA               0.09                 0.876                    0.950
10 7g35w-sL_JA               0.1                  0.850                    0.950
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.2 Grafik Fungsi for the 2021.
The data was retrieved on 7 January 2024.

```
# A tibble: 600 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 aHo1kbccgLM               0.01                 1.01                     0.725
 2 aHo1kbccgLM               0.02                 0.867                    0.832
 3 aHo1kbccgLM               0.03                 0.876                    0.910
 4 aHo1kbccgLM               0.04                 0.895                    0.940
 5 aHo1kbccgLM               0.05                 0.943                    0.949
 6 aHo1kbccgLM               0.06                 0.971                    0.950
 7 aHo1kbccgLM               0.07                 1                        0.950
 8 aHo1kbccgLM               0.08                 0.971                    0.950
 9 aHo1kbccgLM               0.09                 1.01                     0.950
10 aHo1kbccgLM               0.1                  0.924                    0.950
# i 590 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.3 Informasi Penting Grafik
Fungsi. The data was retrieved on 7 January 2024 from Youtube API Explorer with these
codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTimeR
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
```

```
 1 MD5LDDmH3Lo              0.01               1                0.773
 2 MD5LDDmH3Lo              0.02               0.884            0.872
 3 MD5LDDmH3Lo              0.03               0.990            0.934
 4 MD5LDDmH3Lo              0.04               0.958            0.949
 5 MD5LDDmH3Lo              0.05               0.916            0.951
 6 MD5LDDmH3Lo              0.06               0.905            0.951
 7 MD5LDDmH3Lo              0.07               0.926            0.951
 8 MD5LDDmH3Lo              0.08               0.916            0.951
 9 MD5LDDmH3Lo              0.09               0.926            0.951
10 MD5LDDmH3Lo              0.1                0.979            0.951
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.4 Fungsi Linear dan Model-nya. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 LIkQgdMtovQ               0.01                 1.05                      0.711
 2 LIkQgdMtovQ               0.02                 0.920                     0.808
 3 LIkQgdMtovQ               0.03                 0.875                     0.873
 4 LIkQgdMtovQ               0.04                 0.807                     0.895
 5 LIkQgdMtovQ               0.05                 0.818                     0.906
 6 LIkQgdMtovQ               0.06                 0.807                     0.919
 7 LIkQgdMtovQ               0.07                 0.807                     0.932
 8 LIkQgdMtovQ               0.08                 0.852                     0.942
 9 LIkQgdMtovQ               0.09                 0.886                     0.947
10 LIkQgdMtovQ               0.1                  0.920                     0.949
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.5 Transformasi Fungsi. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 600 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 jytZgg-oQyM               0.01                 1.03                     0.676
 2 jytZgg-oQyM               0.02                 1                        0.781
 3 jytZgg-oQyM               0.03                 0.931                    0.852
 4 jytZgg-oQyM               0.04                 0.861                    0.877
 5 jytZgg-oQyM               0.05                 0.833                    0.888
 6 jytZgg-oQyM               0.06                 0.875                    0.898
 7 jytZgg-oQyM               0.07                 0.889                    0.905
 8 jytZgg-oQyM               0.08                 0.875                    0.907
 9 jytZgg-oQyM               0.09                 0.833                    0.908
10 jytZgg-oQyM               0.1                  0.889                    0.909
# i 590 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.6 Kombinasi Beberapa
Fungsi. The data was retrieved on 7 January 2024 from Youtube API Explorer with
these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 oKlJDBsc_A0               0.01                 0.956                    0.633
 2 oKlJDBsc_A0               0.02                 0.769                    0.752
 3 oKlJDBsc_A0               0.03                 0.736                    0.84
 4 oKlJDBsc_A0               0.04                 0.802                    0.866
 5 oKlJDBsc_A0               0.05                 0.758                    0.848
 6 oKlJDBsc_A0               0.06                 0.714                    0.794
 7 oKlJDBsc_A0               0.07                 0.659                    0.719
 8 oKlJDBsc_A0               0.08                 0.681                    0.655
 9 oKlJDBsc_A0               0.09                 0.648                    0.625
10 oKlJDBsc_A0               0.1                  0.615                    0.628
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 2.7 Fungsi Satu-Satu dan
Inversnya. The data was retrieved on 7 January 2024 from Youtube API Explorer with
these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
```

```
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed


# A tibble: 500 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 hcUC4IFisL4               0.01                0.908                     0.564
 2 hcUC4IFisL4               0.02                0.776                     0.694
 3 hcUC4IFisL4               0.03                0.710                     0.805
 4 hcUC4IFisL4               0.04                0.710                     0.871
 5 hcUC4IFisL4               0.05                0.763                     0.909
 6 hcUC4IFisL4               0.06                0.790                     0.928
 7 hcUC4IFisL4               0.07                0.790                     0.933
 8 hcUC4IFisL4               0.08                0.737                     0.931
 9 hcUC4IFisL4               0.09                0.710                     0.928
10 hcUC4IFisL4               0.1                 0.697                     0.928
# i 490 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopic data into one topic.

```
# A tibble: 3,100 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1   year
   <chr>                 <dbl>                <dbl>                  <dbl>  <dbl>
 1 7g35w-s~               0.01                 1.03                  0.721   2021
 2 7g35w-s~               0.02                0.858                  0.825   2021
 3 7g35w-s~               0.03                0.850                  0.901   2021
 4 7g35w-s~               0.04                0.876                  0.933   2021
 5 7g35w-s~               0.05                0.903                  0.946   2021
 6 7g35w-s~               0.06                0.903                  0.950   2021
 7 7g35w-s~               0.07                0.920                  0.950   2021
 8 7g35w-s~               0.08                0.885                  0.950   2021
 9 7g35w-s~               0.09                0.876                  0.950   2021
10 7g35w-s~               0.1                 0.850                  0.950   2021
# i 3,090 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.2.3 Two Year Data

```
retention_2 <- bind_rows(retention_2020_2,
                         retention_2021_2)

write_csv(retention_2,
          file = "datasets/retention_2.csv")

print(retention_2)
```

```
# A tibble: 6,200 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                 <dbl>                <dbl>                  <dbl> <dbl>
 1 7g35w-s~               0.01                0.991                  0.696  2020
 2 7g35w-s~               0.02                0.894                  0.817  2020
 3 7g35w-s~               0.03                0.832                  0.905  2020
 4 7g35w-s~               0.04                0.858                  0.940  2020
 5 7g35w-s~               0.05                0.832                  0.949  2020
 6 7g35w-s~               0.06                0.858                  0.950  2020
 7 7g35w-s~               0.07                0.823                  0.950  2020
 8 7g35w-s~               0.08                0.832                  0.950  2020
 9 7g35w-s~               0.09                0.796                  0.950  2020
10 7g35w-s~               0.1                 0.832                  0.950  2020
# i 6,190 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.3 Rational Functions

2.3.1 2020

Retrieving audience retention data of videos from subtopic 3.1 Fungsi Rasional. The data
was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 fS8JmmjCg4Y               0.01                0.954                     0.660
 2 fS8JmmjCg4Y               0.02                0.853                     0.760
 3 fS8JmmjCg4Y               0.03                0.767                     0.823
 4 fS8JmmjCg4Y               0.04                0.705                     0.838
 5 fS8JmmjCg4Y               0.05                0.690                     0.842
 6 fS8JmmjCg4Y               0.06                0.667                     0.853
 7 fS8JmmjCg4Y               0.07                0.659                     0.869
 8 fS8JmmjCg4Y               0.08                0.690                     0.884
 9 fS8JmmjCg4Y               0.09                0.674                     0.897
10 fS8JmmjCg4Y               0.1                 0.643                     0.908
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 3.2 Grafik Fungsi Rasional. The
data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 7Ji0rZA-D7k               0.01                1.01                      0.725
 2 7Ji0rZA-D7k               0.02                0.817                     0.821
 3 7Ji0rZA-D7k               0.03                0.742                     0.888
 4 7Ji0rZA-D7k               0.04                0.656                     0.910
 5 7Ji0rZA-D7k               0.05                0.688                     0.916
 6 7Ji0rZA-D7k               0.06                0.667                     0.919
 7 7Ji0rZA-D7k               0.07                0.570                     0.921
 8 7Ji0rZA-D7k               0.08                0.570                     0.923
 9 7Ji0rZA-D7k               0.09                0.645                     0.926
10 7Ji0rZA-D7k               0.1                 0.634                     0.930
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 3.3 Pertidaksamaan Rasional.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 quoIHoqCJs4               0.01                0.966                     0.772
 2 quoIHoqCJs4               0.02                0.864                     0.867
 3 quoIHoqCJs4               0.03                0.864                     0.925
 4 quoIHoqCJs4               0.04                0.796                     0.938
 5 quoIHoqCJs4               0.05                0.739                     0.940
 6 quoIHoqCJs4               0.06                0.716                     0.940
 7 quoIHoqCJs4               0.07                0.693                     0.940
 8 quoIHoqCJs4               0.08                0.648                     0.939
 9 quoIHoqCJs4               0.09                0.693                     0.935
10 quoIHoqCJs4               0.1                 0.682                     0.928
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopics into one topic data.

```
# A tibble: 900 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1   year
   <chr>                 <dbl>                <dbl>                  <dbl>  <dbl>
 1 fS8Jmmj~               0.01                0.954                  0.660   2020
 2 fS8Jmmj~               0.02                0.853                  0.760   2020
 3 fS8Jmmj~               0.03                0.767                  0.823   2020
 4 fS8Jmmj~               0.04                0.705                  0.838   2020
 5 fS8Jmmj~               0.05                0.690                  0.842   2020
 6 fS8Jmmj~               0.06                0.667                  0.853   2020
 7 fS8Jmmj~               0.07                0.659                  0.869   2020
 8 fS8Jmmj~               0.08                0.690                  0.884   2020
 9 fS8Jmmj~               0.09                0.674                  0.897   2020
10 fS8Jmmj~               0.1                 0.643                  0.908   2020
# i 890 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.3.2 2021

Retrieving audience retention data of videos from subtopic 3.1 Fungsi Rasional. The data
was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 fS8JmmjCg4Y                0.01                0.971                     0.674
 2 fS8JmmjCg4Y                0.02                0.754                     0.771
 3 fS8JmmjCg4Y                0.03                0.696                     0.845
 4 fS8JmmjCg4Y                0.04                0.659                     0.885
 5 fS8JmmjCg4Y                0.05                0.630                     0.913
 6 fS8JmmjCg4Y                0.06                0.659                     0.931
 7 fS8JmmjCg4Y                0.07                0.681                     0.940
 8 fS8JmmjCg4Y                0.08                0.652                     0.944
 9 fS8JmmjCg4Y                0.09                0.674                     0.944
10 fS8JmmjCg4Y                0.1                 0.725                     0.943
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 3.2 Grafik Fungsi Rasional. The
data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 7Ji0rZA-D7k                0.01                0.966                     0.749
 2 7Ji0rZA-D7k                0.02                0.716                     0.837
 3 7Ji0rZA-D7k                0.03                0.716                     0.896
 4 7Ji0rZA-D7k                0.04                0.636                     0.915
 5 7Ji0rZA-D7k                0.05                0.557                     0.918
 6 7Ji0rZA-D7k                0.06                0.557                     0.919
 7 7Ji0rZA-D7k                0.07                0.568                     0.921
 8 7Ji0rZA-D7k                0.08                0.557                     0.924
 9 7Ji0rZA-D7k                0.09                0.523                     0.927
10 7Ji0rZA-D7k                0.1                 0.546                     0.930
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 3.3 Pertidaksamaan Rasional.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 quoIHoqCJs4                0.01                0.971                     0.762
 2 quoIHoqCJs4                0.02                0.714                     0.865
 3 quoIHoqCJs4                0.03                0.657                     0.931
 4 quoIHoqCJs4                0.04                0.757                     0.948
 5 quoIHoqCJs4                0.05                0.714                     0.950
 6 quoIHoqCJs4                0.06                0.7                       0.947
 7 quoIHoqCJs4                0.07                0.7                       0.938
 8 quoIHoqCJs4                0.08                0.671                     0.919
 9 quoIHoqCJs4                0.09                0.614                     0.896
10 quoIHoqCJs4                0.1                 0.614                     0.885
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopics into one topic data.

```
# A tibble: 900 x 5
   vid_id    elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                  <dbl>                <dbl>                  <dbl> <dbl>
 1 fS8Jmmj~                0.01                0.971                  0.674  2021
 2 fS8Jmmj~                0.02                0.754                  0.771  2021
 3 fS8Jmmj~                0.03                0.696                  0.845  2021
 4 fS8Jmmj~                0.04                0.659                  0.885  2021
 5 fS8Jmmj~                0.05                0.630                  0.913  2021
 6 fS8Jmmj~                0.06                0.659                  0.931  2021
 7 fS8Jmmj~                0.07                0.681                  0.940  2021
 8 fS8Jmmj~                0.08                0.652                  0.944  2021
 9 fS8Jmmj~                0.09                0.674                  0.944  2021
10 fS8Jmmj~                0.1                 0.725                  0.943  2021
# i 890 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.3.3 Two Year Data

```r
retention_3 <- bind_rows(retention_2020_3,
                         retention_2021_3)

write_csv(retention_3,
          file = "datasets/retention_3.csv")

print(retention_3)
```

```
# A tibble: 1,800 x 5
   vid_id    elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                  <dbl>                <dbl>                  <dbl> <dbl>
 1 fS8Jmmj~                0.01                0.954                  0.660  2020
 2 fS8Jmmj~                0.02                0.853                  0.760  2020
 3 fS8Jmmj~                0.03                0.767                  0.823  2020
 4 fS8Jmmj~                0.04                0.705                  0.838  2020
 5 fS8Jmmj~                0.05                0.690                  0.842  2020
 6 fS8Jmmj~                0.06                0.667                  0.853  2020
 7 fS8Jmmj~                0.07                0.659                  0.869  2020
 8 fS8Jmmj~                0.08                0.690                  0.884  2020
 9 fS8Jmmj~                0.09                0.674                  0.897  2020
10 fS8Jmmj~                0.1                 0.643                  0.908  2020
# i 1,790 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.4 Exponential and Logarithmic Functions

2.4.1 2020

Retrieving audience retention data of videos from subtopic 4.1 Fungsi Eksponen. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 zG5DYRKRrRI               0.01                 1.01                     0.666
 2 zG5DYRKRrRI               0.02                 0.876                    0.754
 3 zG5DYRKRrRI               0.03                 0.876                    0.814
 4 zG5DYRKRrRI               0.04                 0.804                    0.838
 5 zG5DYRKRrRI               0.05                 0.825                    0.853
 6 zG5DYRKRrRI               0.06                 0.814                    0.866
 7 zG5DYRKRrRI               0.07                 0.814                    0.878
 8 zG5DYRKRrRI               0.08                 0.835                    0.887
 9 zG5DYRKRrRI               0.09                 0.825                    0.894
10 zG5DYRKRrRI               0.1                  0.835                    0.900
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.2 Fungsi Eksponen Alami. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 s-HXONcVGco               0.01                 0.902                    0.684
 2 s-HXONcVGco               0.02                 0.761                    0.796
 3 s-HXONcVGco               0.03                 0.696                    0.882
 4 s-HXONcVGco               0.04                 0.685                    0.921
 5 s-HXONcVGco               0.05                 0.728                    0.939
 6 s-HXONcVGco               0.06                 0.706                    0.947
 7 s-HXONcVGco               0.07                 0.728                    0.949
```

```
 8 s-HXONcVGco              0.08                0.728                    0.950
 9 s-HXONcVGco              0.09                0.663                    0.95
10 s-HXONcVGco              0.1                 0.706                    0.95
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.3 Fungsi Logaritma. The
data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTim
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                    <dbl>
 1 wjQracmCEag              0.01                0.933                    0.458
 2 wjQracmCEag              0.02                0.733                    0.595
 3 wjQracmCEag              0.03                0.717                    0.733
 4 wjQracmCEag              0.04                0.717                    0.831
 5 wjQracmCEag              0.05                0.717                    0.888
 6 wjQracmCEag              0.06                0.667                    0.914
 7 wjQracmCEag              0.07                0.717                    0.925
 8 wjQracmCEag              0.08                0.733                    0.930
 9 wjQracmCEag              0.09                0.7                      0.933
10 wjQracmCEag              0.1                 0.75                     0.933
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.4 Sifat-Sifat Logaritma. The
data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTim
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                    <dbl>
 1 WnEOIIOOEQO              0.01                1.03                     0.602
 2 WnEOIIOOEQO              0.02                0.871                    0.678
 3 WnEOIIOOEQO              0.03                0.790                    0.715
 4 WnEOIIOOEQO              0.04                0.758                    0.703
```

```
 5 WnEOIIOOEQO              0.05                 0.694                   0.675
 6 WnEOIIOOEQO              0.06                 0.742                   0.649
 7 WnEOIIOOEQO              0.07                 0.742                   0.635
 8 WnEOIIOOEQO              0.08                 0.726                   0.638
 9 WnEOIIOOEQO              0.09                 0.742                   0.658
10 WnEOIIOOEQO              0.1                  0.726                   0.687
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.5 Persamaan-Persamaan Eksponen dan Logaritma. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 gcx2CLY3GD4                0.01                 1.01                     0.746
 2 gcx2CLY3GD4                0.02                 0.714                    0.837
 3 gcx2CLY3GD4                0.03                 0.636                    0.891
 4 gcx2CLY3GD4                0.04                 0.662                    0.896
 5 gcx2CLY3GD4                0.05                 0.649                    0.884
 6 gcx2CLY3GD4                0.06                 0.649                    0.870
 7 gcx2CLY3GD4                0.07                 0.649                    0.867
 8 gcx2CLY3GD4                0.08                 0.662                    0.879
 9 gcx2CLY3GD4                0.09                 0.623                    0.900
10 gcx2CLY3GD4                0.1                  0.636                    0.921
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopics into one topic data.

```
# A tibble: 1,400 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                 <dbl>                <dbl>                 <dbl> <dbl>
 1 zG5DYRK~               0.01                 1.01                 0.666  2020
 2 zG5DYRK~               0.02                 0.876                0.754  2020
 3 zG5DYRK~               0.03                 0.876                0.814  2020
 4 zG5DYRK~               0.04                 0.804                0.838  2020
 5 zG5DYRK~               0.05                 0.825                0.853  2020
 6 zG5DYRK~               0.06                 0.814                0.866  2020
 7 zG5DYRK~               0.07                 0.814                0.878  2020
 8 zG5DYRK~               0.08                 0.835                0.887  2020
```

```
 9 zG5DYRK~              0.09              0.825              0.894  2020
10 zG5DYRK~              0.1               0.835              0.900  2020
# i 1,390 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.4.2 2021

Retrieving audience retention data of videos from subtopic 4.1 Fungsi Eksponen. The
data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 zG5DYRKRrRI                0.01                0.989                     0.677
 2 zG5DYRKRrRI                0.02                0.956                     0.747
 3 zG5DYRKRrRI                0.03                0.833                     0.791
 4 zG5DYRKRrRI                0.04                0.8                       0.805
 5 zG5DYRKRrRI                0.05                0.767                     0.810
 6 zG5DYRKRrRI                0.06                0.756                     0.810
 7 zG5DYRKRrRI                0.07                0.733                     0.802
 8 zG5DYRKRrRI                0.08                0.711                     0.792
 9 zG5DYRKRrRI                0.09                0.744                     0.790
10 zG5DYRKRrRI                0.1                 0.711                     0.797
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.2 Fungsi Eksponen Alami.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 s-HXONcVGco                0.01                0.974                     0.626
 2 s-HXONcVGco                0.02                0.769                     0.733
 3 s-HXONcVGco                0.03                0.731                     0.82
```

```
 4 s-HX0NcVGco            0.04            0.756            0.873
 5 s-HX0NcVGco            0.05            0.705            0.909
 6 s-HX0NcVGco            0.06            0.808            0.931
 7 s-HX0NcVGco            0.07            0.795            0.944
 8 s-HX0NcVGco            0.08            0.795            0.949
 9 s-HX0NcVGco            0.09            0.782            0.950
10 s-HX0NcVGco            0.1             0.756            0.950
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.3 Fungsi Logaritma. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 400 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
 1 wjQracmCEag             0.01                1                         0.729
 2 wjQracmCEag             0.02                0.656                     0.773
 3 wjQracmCEag             0.03                0.557                     0.780
 4 wjQracmCEag             0.04                0.525                     0.753
 5 wjQracmCEag             0.05                0.492                     0.728
 6 wjQracmCEag             0.06                0.475                     0.720
 7 wjQracmCEag             0.07                0.492                     0.726
 8 wjQracmCEag             0.08                0.508                     0.731
 9 wjQracmCEag             0.09                0.508                     0.727
10 wjQracmCEag             0.1                 0.475                     0.733
# i 390 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.4 Sifat-Sifat Logaritma. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                   <dbl>                <dbl>                     <dbl>
```

```
 1 WnE0IIO0EQ0              0.01              0.985              0.542
 2 WnE0IIO0EQ0              0.02              0.754              0.603
 3 WnE0IIO0EQ0              0.03              0.708              0.633
 4 WnE0IIO0EQ0              0.04              0.738              0.638
 5 WnE0IIO0EQ0              0.05              0.646              0.643
 6 WnE0IIO0EQ0              0.06              0.677              0.653
 7 WnE0IIO0EQ0              0.07              0.615              0.664
 8 WnE0IIO0EQ0              0.08              0.677              0.678
 9 WnE0IIO0EQ0              0.09              0.646              0.697
10 WnE0IIO0EQ0              0.1               0.677              0.721
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 4.5 Persamaan-Persamaan
Eksponen dan Logaritma. The data was retrieved on 7 January 2024 from Youtube API
Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 gcx2CLY3GD4               0.01                0.986                     0.701
 2 gcx2CLY3GD4               0.02                0.710                     0.787
 3 gcx2CLY3GD4               0.03                0.638                     0.839
 4 gcx2CLY3GD4               0.04                0.609                     0.857
 5 gcx2CLY3GD4               0.05                0.609                     0.868
 6 gcx2CLY3GD4               0.06                0.681                     0.879
 7 gcx2CLY3GD4               0.07                0.681                     0.886
 8 gcx2CLY3GD4               0.08                0.623                     0.892
 9 gcx2CLY3GD4               0.09                0.638                     0.894
10 gcx2CLY3GD4               0.1                 0.667                     0.893
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopics into one topic data.

```
# A tibble: 1,400 x 5
   vid_id    elapsed_time_ratio audience_watch_ratio relative_retention_p~1   year
   <chr>                  <dbl>                <dbl>                  <dbl>  <dbl>
 1 zG5DYRK~                0.01                0.989                  0.677   2021
 2 zG5DYRK~                0.02                0.956                  0.747   2021
 3 zG5DYRK~                0.03                0.833                  0.791   2021
 4 zG5DYRK~                0.04                0.8                    0.805   2021
```

```
 5 zG5DYRK~                      0.05                      0.767                      0.810  2021
 6 zG5DYRK~                      0.06                      0.756                      0.810  2021
 7 zG5DYRK~                      0.07                      0.733                      0.802  2021
 8 zG5DYRK~                      0.08                      0.711                      0.792  2021
 9 zG5DYRK~                      0.09                      0.744                      0.790  2021
10 zG5DYRK~                      0.1                       0.711                      0.797  2021
# i 1,390 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.4.3 Two Year Data

```r
retention_4 <- bind_rows(retention_2020_4,
                         retention_2021_4)

write_csv(retention_4,
          file = "datasets/retention_4.csv")

print(retention_4)
```

```
# A tibble: 2,800 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1   year
   <chr>                 <dbl>                <dbl>                  <dbl>  <dbl>
 1 zG5DYRK~               0.01                 1.01                  0.666   2020
 2 zG5DYRK~               0.02                 0.876                 0.754   2020
 3 zG5DYRK~               0.03                 0.876                 0.814   2020
 4 zG5DYRK~               0.04                 0.804                 0.838   2020
 5 zG5DYRK~               0.05                 0.825                 0.853   2020
 6 zG5DYRK~               0.06                 0.814                 0.866   2020
 7 zG5DYRK~               0.07                 0.814                 0.878   2020
 8 zG5DYRK~               0.08                 0.835                 0.887   2020
 9 zG5DYRK~               0.09                 0.825                 0.894   2020
10 zG5DYRK~               0.1                  0.835                 0.900   2020
# i 2,790 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.5 Trigonometric Functions

2.5.1 2020

Retrieving audience retention data of videos from subtopic 5.1 Sudut dan Ukuran Sudut.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 U6jWizrcoaw               0.01                1.02                      0.648
 2 U6jWizrcoaw               0.02                0.794                     0.748
 3 U6jWizrcoaw               0.03                0.722                     0.827
 4 U6jWizrcoaw               0.04                0.742                     0.865
 5 U6jWizrcoaw               0.05                0.711                     0.882
 6 U6jWizrcoaw               0.06                0.732                     0.889
 7 U6jWizrcoaw               0.07                0.711                     0.888
 8 U6jWizrcoaw               0.08                0.670                     0.881
 9 U6jWizrcoaw               0.09                0.660                     0.872
10 U6jWizrcoaw               0.1                 0.650                     0.869
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 5.2 Trigonometri Segitiga Siku-Siku. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 3MQ47s45dnU               0.01                1.01                      0.766
 2 3MQ47s45dnU               0.02                0.878                     0.869
 3 3MQ47s45dnU               0.03                0.865                     0.933
 4 3MQ47s45dnU               0.04                0.865                     0.949
 5 3MQ47s45dnU               0.05                0.865                     0.950
 6 3MQ47s45dnU               0.06                0.797                     0.950
 7 3MQ47s45dnU               0.07                0.797                     0.950
 8 3MQ47s45dnU               0.08                0.824                     0.950
 9 3MQ47s45dnU               0.09                0.770                     0.950
10 3MQ47s45dnU               0.1                 0.743                     0.949
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 5.3 Fungsi Trigonometri Sembarang Sudut. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
```

```
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 500 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 bn91Bs6pE1o                0.01                1.03                      0.605
 2 bn91Bs6pE1o                0.02                0.894                     0.734
 3 bn91Bs6pE1o                0.03                0.879                     0.842
 4 bn91Bs6pE1o                0.04                0.939                     0.899
 5 bn91Bs6pE1o                0.05                0.879                     0.926
 6 bn91Bs6pE1o                0.06                0.879                     0.939
 7 bn91Bs6pE1o                0.07                0.894                     0.945
 8 bn91Bs6pE1o                0.08                0.864                     0.949
 9 bn91Bs6pE1o                0.09                0.848                     0.950
10 bn91Bs6pE1o                0.1                 0.894                     0.950
# i 490 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 5.4 Grafik Fungsi Trigonometri.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 Zk_xFgb6Y7Y                0.01                1.14                      0.793
 2 Zk_xFgb6Y7Y                0.02                0.825                     0.882
 3 Zk_xFgb6Y7Y                0.03                0.788                     0.937
 4 Zk_xFgb6Y7Y                0.04                0.838                     0.949
 5 Zk_xFgb6Y7Y                0.05                0.75                      0.948
 6 Zk_xFgb6Y7Y                0.06                0.7                       0.941
 7 Zk_xFgb6Y7Y                0.07                0.7                       0.930
 8 Zk_xFgb6Y7Y                0.08                0.688                     0.915
 9 Zk_xFgb6Y7Y                0.09                0.688                     0.901
10 Zk_xFgb6Y7Y                0.1                 0.675                     0.893
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopics into topic data.

```
# A tibble: 1,300 x 5
   vid_id    elapsed_time_ratio audience_watch_ratio relative_retention_p~1   year
   <chr>                  <dbl>                <dbl>                  <dbl>  <dbl>
 1 U6jWizr~                0.01                 1.02                  0.648   2020
 2 U6jWizr~                0.02                0.794                  0.748   2020
 3 U6jWizr~                0.03                0.722                  0.827   2020
 4 U6jWizr~                0.04                0.742                  0.865   2020
 5 U6jWizr~                0.05                0.711                  0.882   2020
 6 U6jWizr~                0.06                0.732                  0.889   2020
 7 U6jWizr~                0.07                0.711                  0.888   2020
 8 U6jWizr~                0.08                0.670                  0.881   2020
 9 U6jWizr~                0.09                0.660                  0.872   2020
10 U6jWizr~                0.1                 0.650                  0.869   2020
# i 1,290 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.5.2 2021

Retrieving audience retention data of videos from subtopic 5.1 Sudut dan Ukuran Sudut.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 200 x 4
   vid_id       elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                     <dbl>                <dbl>                     <dbl>
 1 U6jWizrcoaw                0.01                 1                         0.570
 2 U6jWizrcoaw                0.02                0.833                      0.697
 3 U6jWizrcoaw                0.03                0.833                      0.807
 4 U6jWizrcoaw                0.04                0.795                      0.872
 5 U6jWizrcoaw                0.05                0.820                      0.908
 6 U6jWizrcoaw                0.06                0.833                      0.925
 7 U6jWizrcoaw                0.07                0.820                      0.930
 8 U6jWizrcoaw                0.08                0.795                      0.927
 9 U6jWizrcoaw                0.09                0.756                      0.920
10 U6jWizrcoaw                0.1                 0.744                      0.914
# i 190 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 5.2 Trigonometri Segitiga Siku-
Siku. The data was retrieved on 7 January 2024 from Youtube API Explorer with these
codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 3MQ47s45dnU               0.01                1.04                      0.772
 2 3MQ47s45dnU               0.02                0.870                     0.870
 3 3MQ47s45dnU               0.03                0.913                     0.933
 4 3MQ47s45dnU               0.04                0.870                     0.949
 5 3MQ47s45dnU               0.05                0.855                     0.951
 6 3MQ47s45dnU               0.06                0.841                     0.951
 7 3MQ47s45dnU               0.07                0.870                     0.951
 8 3MQ47s45dnU               0.08                0.841                     0.951
 9 3MQ47s45dnU               0.09                0.841                     0.951
10 3MQ47s45dnU               0.1                 0.855                     0.951
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 5.3 Fungsi Trigonometri Sembarang Sudut. The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 500 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 bn91Bs6pE1o               0.01                0.985                     0.751
 2 bn91Bs6pE1o               0.02                0.846                     0.849
 3 bn91Bs6pE1o               0.03                0.846                     0.913
 4 bn91Bs6pE1o               0.04                0.831                     0.933
 5 bn91Bs6pE1o               0.05                0.831                     0.941
 6 bn91Bs6pE1o               0.06                0.815                     0.946
 7 bn91Bs6pE1o               0.07                0.8                       0.949
 8 bn91Bs6pE1o               0.08                0.8                       0.949
 9 bn91Bs6pE1o               0.09                0.846                     0.947
10 bn91Bs6pE1o               0.1                 0.8                       0.943
# i 490 more rows
# i abbreviated name: 1: relative_retention_performance
```

Retrieving audience retention data of videos from subtopic 5.4 Grafik Fungsi Trigonometri.
The data was retrieved on 7 January 2024 from Youtube API Explorer with these codes.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2CelapsedVideoTime
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```
# A tibble: 300 x 4
   vid_id      elapsed_time_ratio audience_watch_ratio relative_retention_perf~1
   <chr>                    <dbl>                <dbl>                     <dbl>
 1 Zk_xFgb6Y7Y               0.01                1                         0.737
 2 Zk_xFgb6Y7Y               0.02                0.893                     0.830
 3 Zk_xFgb6Y7Y               0.03                0.857                     0.887
 4 Zk_xFgb6Y7Y               0.04                0.839                     0.896
 5 Zk_xFgb6Y7Y               0.05                0.839                     0.888
 6 Zk_xFgb6Y7Y               0.06                0.839                     0.874
 7 Zk_xFgb6Y7Y               0.07                0.786                     0.855
 8 Zk_xFgb6Y7Y               0.08                0.786                     0.835
 9 Zk_xFgb6Y7Y               0.09                0.786                     0.824
10 Zk_xFgb6Y7Y               0.1                 0.714                     0.831
# i 290 more rows
# i abbreviated name: 1: relative_retention_performance
```

Combining subtopics into topic data.

```
# A tibble: 1,300 x 5
   vid_id  elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                <dbl>                <dbl>                  <dbl> <dbl>
 1 U6jWizr~              0.01                1                      0.570  2021
 2 U6jWizr~              0.02                0.833                  0.697  2021
 3 U6jWizr~              0.03                0.833                  0.807  2021
 4 U6jWizr~              0.04                0.795                  0.872  2021
 5 U6jWizr~              0.05                0.820                  0.908  2021
 6 U6jWizr~              0.06                0.833                  0.925  2021
 7 U6jWizr~              0.07                0.820                  0.930  2021
 8 U6jWizr~              0.08                0.795                  0.927  2021
 9 U6jWizr~              0.09                0.756                  0.920  2021
10 U6jWizr~              0.1                 0.744                  0.914  2021
# i 1,290 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.5.3 Two Year Data

```r
retention_5 <- bind_rows(retention_2020_5,
                         retention_2021_5)

write_csv(retention_5,
          file = "datasets/retention_5.csv")

print(retention_5)
```

```
# A tibble: 2,600 x 5
   vid_id   elapsed_time_ratio audience_watch_ratio relative_retention_p~1  year
   <chr>                 <dbl>                <dbl>                  <dbl> <dbl>
 1 U6jWizr~               0.01                 1.02                  0.648  2020
 2 U6jWizr~               0.02                0.794                  0.748  2020
 3 U6jWizr~               0.03                0.722                  0.827  2020
 4 U6jWizr~               0.04                0.742                  0.865  2020
 5 U6jWizr~               0.05                0.711                  0.882  2020
 6 U6jWizr~               0.06                0.732                  0.889  2020
 7 U6jWizr~               0.07                0.711                  0.888  2020
 8 U6jWizr~               0.08                0.670                  0.881  2020
 9 U6jWizr~               0.09                0.660                  0.872  2020
10 U6jWizr~               0.1                 0.650                  0.869  2020
# i 2,590 more rows
# i abbreviated name: 1: relative_retention_performance
```

2.6 Combination of Retention Data

```r
retention <- bind_rows(retention_1,
                       retention_2,
                       retention_3,
                       retention_4,
                       retention_5) %>%
  rename(id = vid_id)

video_duration <- video_details %>%
  select(id, title, duration)

retention <- retention %>%
  left_join(video_duration,
            by = join_by(id))

retention <- retention %>%
  relocate(title, .after = id) %>%
  mutate(elapsed_time_mins = elapsed_time_ratio*as.numeric(duration)/60) %>%
  relocate(elapsed_time_mins, .before = elapsed_time_ratio)
```

```r
write_csv(retention,
          file = "datasets/retention.csv")

print(retention)
```

```
# A tibble: 18,400 x 8
   id        title  elapsed_time_mins elapsed_time_ratio audience_watch_ratio
   <chr>     <chr>              <dbl>              <dbl>                <dbl>
 1 y7zRv0bPAt4 Bidang~         0.0562               0.01                 1.05
 2 y7zRv0bPAt4 Bidang~         0.112                0.02                 0.897
 3 y7zRv0bPAt4 Bidang~         0.168                0.03                 0.850
 4 y7zRv0bPAt4 Bidang~         0.225                0.04                 0.776
 5 y7zRv0bPAt4 Bidang~         0.281                0.05                 0.757
 6 y7zRv0bPAt4 Bidang~         0.337                0.06                 0.748
 7 y7zRv0bPAt4 Bidang~         0.393                0.07                 0.785
 8 y7zRv0bPAt4 Bidang~         0.449                0.08                 0.794
 9 y7zRv0bPAt4 Bidang~         0.505                0.09                 0.785
10 y7zRv0bPAt4 Bidang~         0.562                0.1                  0.785
# i 18,390 more rows
# i 3 more variables: relative_retention_performance <dbl>, year <dbl>,
#   duration <Period>
```

3 Video Statistics

Statistics of all videos were gathered by using Youtube Analytics and Reporting API with this code.

```
curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2Cday&endDate=2020
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed

curl \
  'https://youtubeanalytics.googleapis.com/v2/reports?dimensions=video%2Cday&endDate=2021
  --header 'Authorization: Bearer [YOUR_ACCESS_TOKEN]' \
  --header 'Accept: application/json' \
  --compressed
```

```r
# For the year 2020
video_stat_2020 <- fromJSON("datasets/video_stat_2020.json",
                            flatten = TRUE)
stat_colnames <- c(as.character(video_stat_2020$columnHeaders$name))

video_stat_2020 <- as.data.frame(video_stat_2020$rows)
```

```r
colnames(video_stat_2020) <- stat_colnames
video_stat_2020 <- video_stat_2020 %>%
  tibble() %>%
  mutate(day = ymd(day),
         views = as.numeric(as.character(views)),
         estimatedMinutesWatched = as.numeric(as.character(estimatedMinutesWatched)),
         likes = as.numeric(as.character(likes)),
         dislikes = as.numeric(as.character(dislikes)),
         comments = as.numeric(as.character(comments)),
         shares = as.numeric(as.character(shares)),
         year = 2020)

# For the year 2021
video_stat_2021 <- fromJSON("datasets/video_stat_2021.json",
                            flatten = TRUE)

video_stat_2021 <- as.data.frame(video_stat_2021$rows)
colnames(video_stat_2021) <- stat_colnames
video_stat_2021 <- video_stat_2021 %>%
  tibble() %>%
  mutate(day = ymd(day),
         views = as.numeric(as.character(views)),
         estimatedMinutesWatched = as.numeric(as.character(estimatedMinutesWatched)),
         likes = as.numeric(as.character(likes)),
         dislikes = as.numeric(as.character(dislikes)),
         comments = as.numeric(as.character(comments)),
         shares = as.numeric(as.character(shares)),
         year = 2021)

# Combining data
video_stat <- bind_rows(video_stat_2020,
                        video_stat_2021)
write_csv(video_stat,
          file = "datasets/video_stat.csv")
```