

# Data Collection

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## 1 Audience Retention

### 1.1 Function

#### 1.1.1 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 Modelnya. 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

```

### 1.1.2 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%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 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 Modelnya. 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
```

### 1.1.3 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
```

## 1.2 Rational Functions

### 1.2.1 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 quoIHqCJs4      0.01          0.966          0.772
2 quoIHqCJs4      0.02          0.864          0.867
3 quoIHqCJs4      0.03          0.864          0.925
4 quoIHqCJs4      0.04          0.796          0.938
5 quoIHqCJs4      0.05          0.739          0.940
6 quoIHqCJs4      0.06          0.716          0.940
7 quoIHqCJs4      0.07          0.693          0.940
8 quoIHqCJs4      0.08          0.648          0.939
9 quoIHqCJs4      0.09          0.693          0.935
10 quoIHqCJs4      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

```

### 1.2.2 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

```

### 1.2.3 Two Year Data

```
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

## 1.3 Exponential and Logarithmic Functions

### 1.3.1 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%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          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%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 WnEOIIO0EQ0          0.01                1.03                0.602
2 WnEOIIO0EQ0          0.02                0.871                0.678
3 WnEOIIO0EQ0          0.03                0.790                0.715
4 WnEOIIO0EQ0          0.04                0.758                0.703
5 WnEOIIO0EQ0          0.05                0.694                0.675
6 WnEOIIO0EQ0          0.06                0.742                0.649
7 WnEOIIO0EQ0          0.07                0.742                0.635
8 WnEOIIO0EQ0          0.08                0.726                0.638
9 WnEOIIO0EQ0          0.09                0.742                0.658
10 WnEOIIO0EQ0         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
```

### 1.3.2 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-HXONcVGco	0.04	0.756	0.873
5	s-HXONcVGco	0.05	0.705	0.909
6	s-HXONcVGco	0.06	0.808	0.931
7	s-HXONcVGco	0.07	0.795	0.944
8	s-HXONcVGco	0.08	0.795	0.949
9	s-HXONcVGco	0.09	0.782	0.950
10	s-HXONcVGco	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 WnEOIIO0EQ0      0.01            0.985        0.542
2 WnEOIIO0EQ0      0.02            0.754        0.603
3 WnEOIIO0EQ0      0.03            0.708        0.633
4 WnEOIIO0EQ0      0.04            0.738        0.638
5 WnEOIIO0EQ0      0.05            0.646        0.643
6 WnEOIIO0EQ0      0.06            0.677        0.653
7 WnEOIIO0EQ0      0.07            0.615        0.664
8 WnEOIIO0EQ0      0.08            0.677        0.678
9 WnEOIIO0EQ0      0.09            0.646        0.697
10 WnEOIIO0EQ0      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
```

### 1.3.3 Two Year Data

```
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
```

## 1.4 Trigonometric Functions

### 1.4.1 2020