

# Metrics

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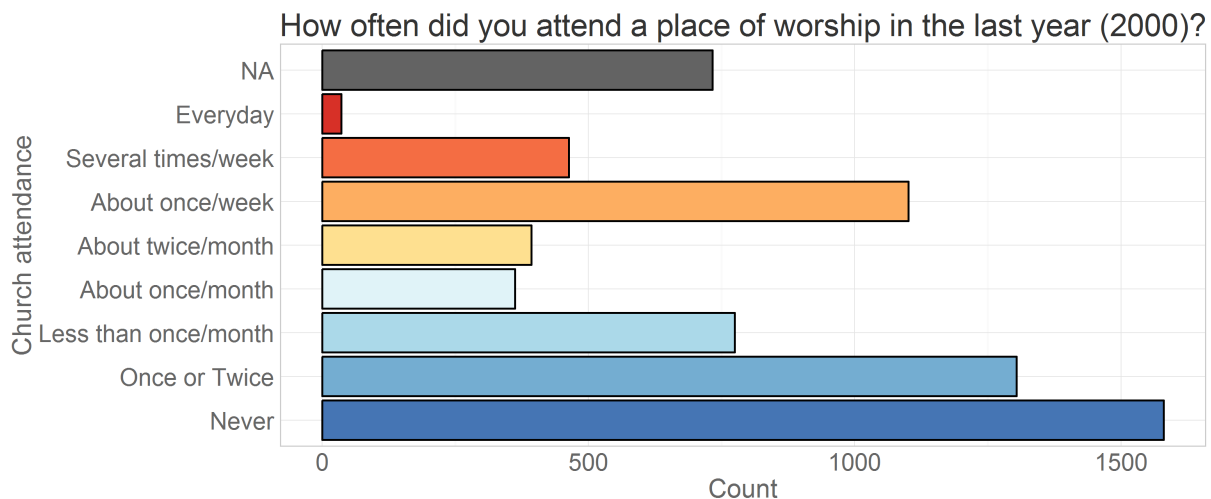
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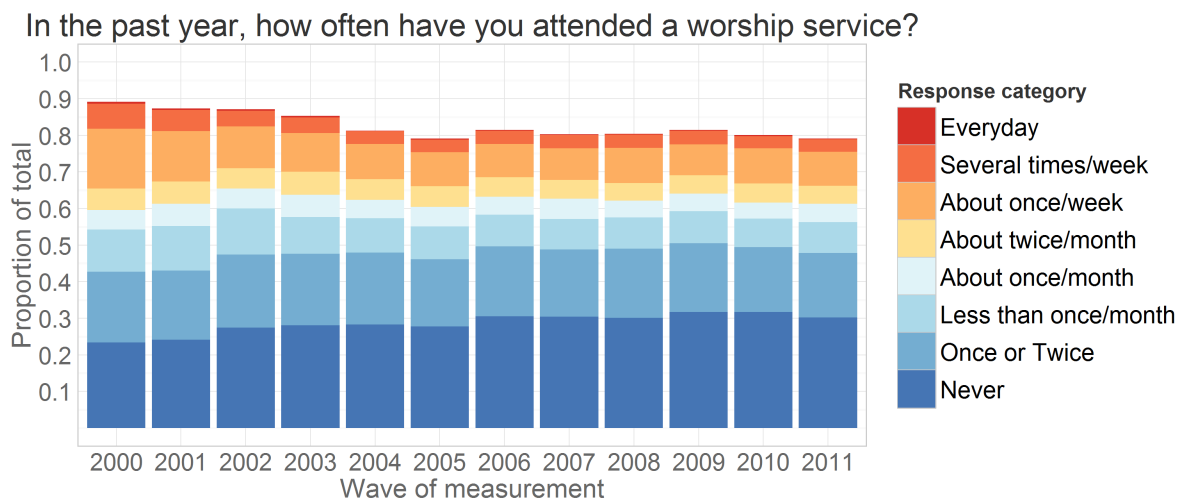
## Mapping Church Attendance in Time

### Cross-Sectional View

The focal variable of interest is **attend**, the item measuring church attendance for the year that preceded the interview date. The questionnaire recorded the responses on the ordinal scale.

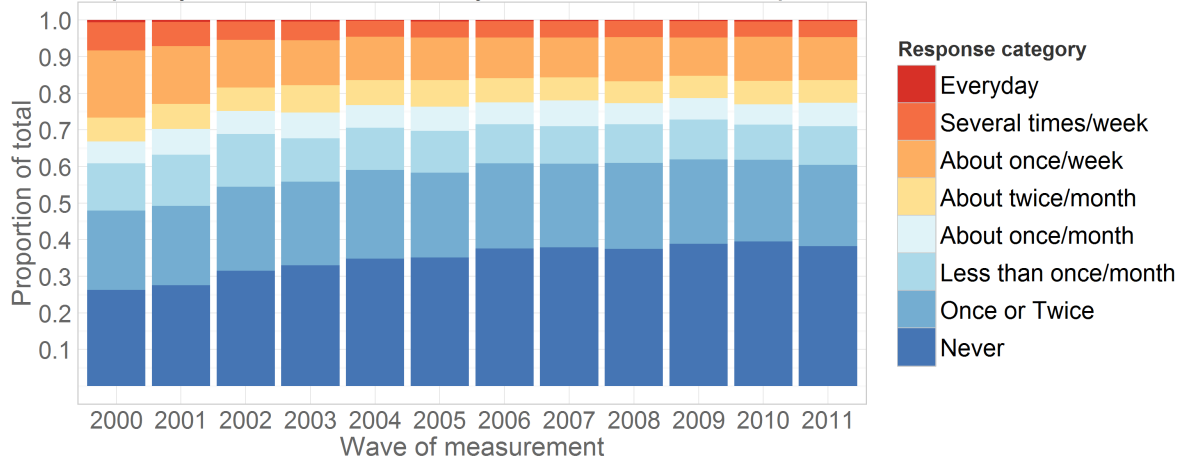


Creating frequency distributions for each of the measurement wave we have:



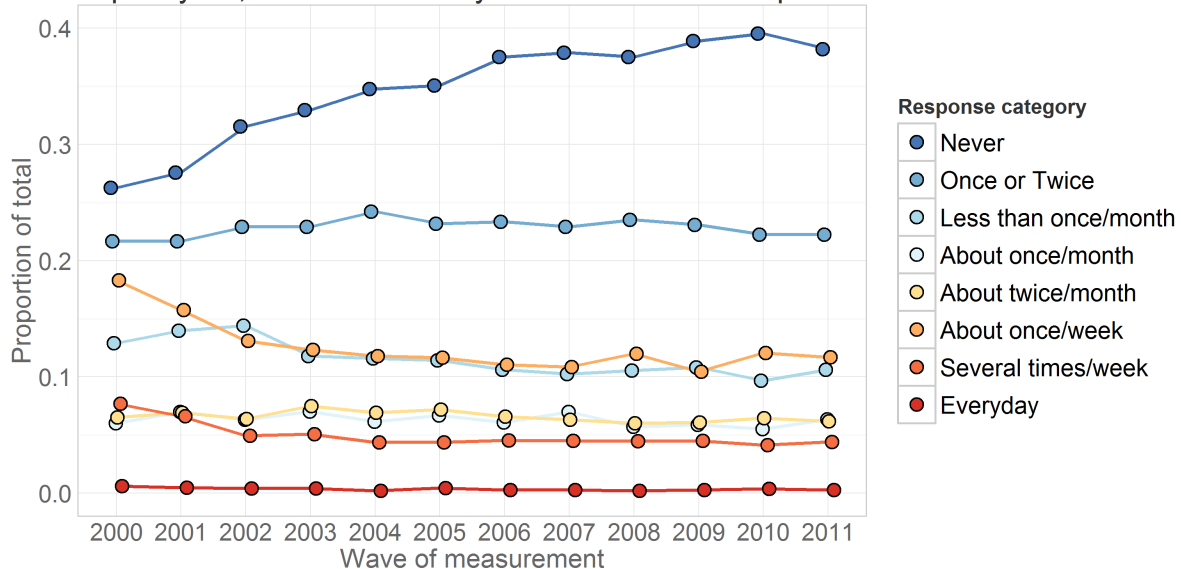
Here, missing values are used in the calculation of total responses to show the natural attrition in the study. Assuming that attrition is not significantly associated with the outcome measure, we can remove missing values from the calculation of the total and look at prevalence of response endorsements over time.

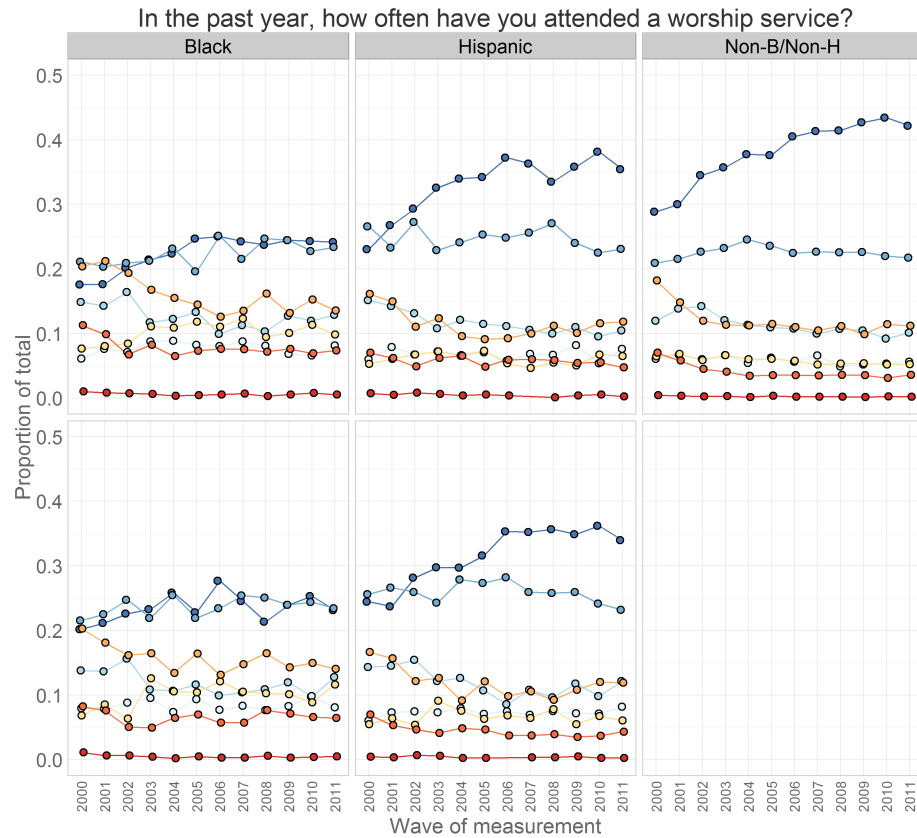
In the past year, how often have you attended a worship service?



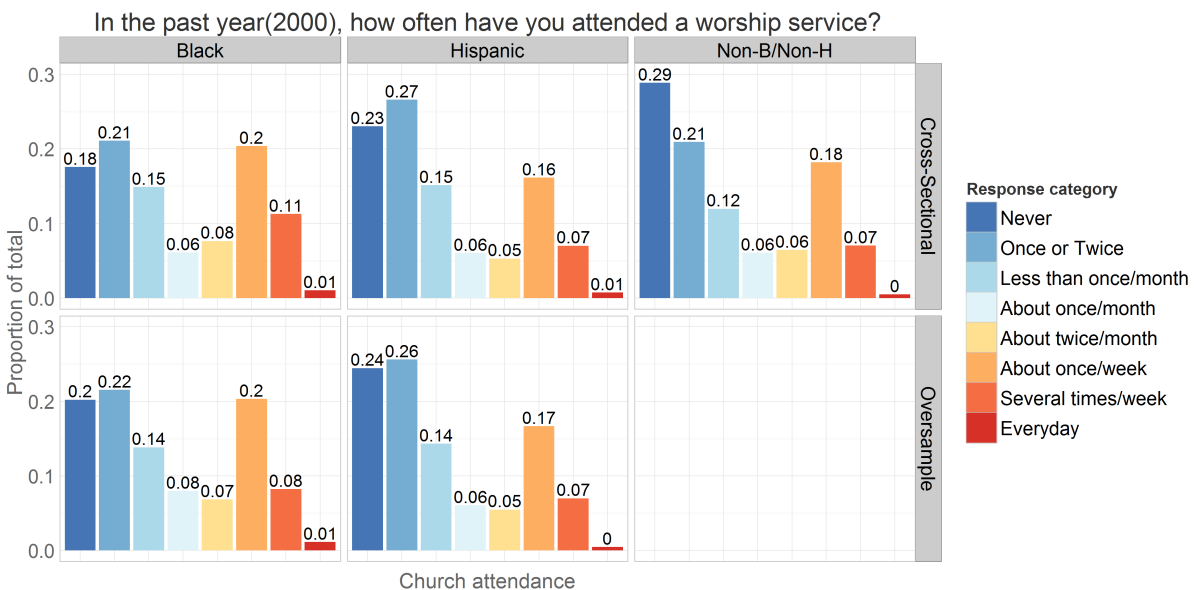
Tracing the rate of change of prevalence in a line graph, we see more clearly which categories increase over time (e.g. "Never"), which decline (e.g. "About once/week"), and which stay relatively stable (e.g. "About twice/month")

In the past year, how often have you attended a worship service?





Inspecting the prevalence trajectories across races.



### Longitudinal View

Graphs above shows change in the cross-sectional distribution of responses over the years. Modeling the change in these response frequencies is handled well by Markov models. LCM, however, works with longitudinal data, modeling the trajectory of each individual and treating attendance as a continuous outcome.

To demonstrate mapping of individual trajectories to time, let's select a dataset that would include personal identifier (**id**), cohort indicator (**byear**), wave of measurement (**year**) and the focal variable of interest - worship attendance (**attend**).

```
ds<- dsL %>% dplyr::filter(year %in% c(2000:2011), id==47) %>%
  dplyr::select(id, byear, year, attend, attendF)
print(ds)
```

	id	byear	year	attend	attendF
1	47	1982	2000	5	About twice/month
2	47	1982	2001	2	Once or Twice
3	47	1982	2002	4	About once/month
4	47	1982	2003	2	Once or Twice
5	47	1982	2004	3	Less than once/month
6	47	1982	2005	2	Once or Twice
7	47	1982	2006	2	Once or Twice
8	47	1982	2007	3	Less than once/month
9	47	1982	2008	2	Once or Twice
10	47	1982	2009	1	Never
11	47	1982	2010	1	Never
12	47	1982	2011	1	Never

The view above lists attendance data for subjust with id = 47. Mapping his attendance to time we have



where vertical dimension maps the outcome value and the horizontal maps the time. There will be a trajectory for each of the

```
length(unique(dsL$id))
```

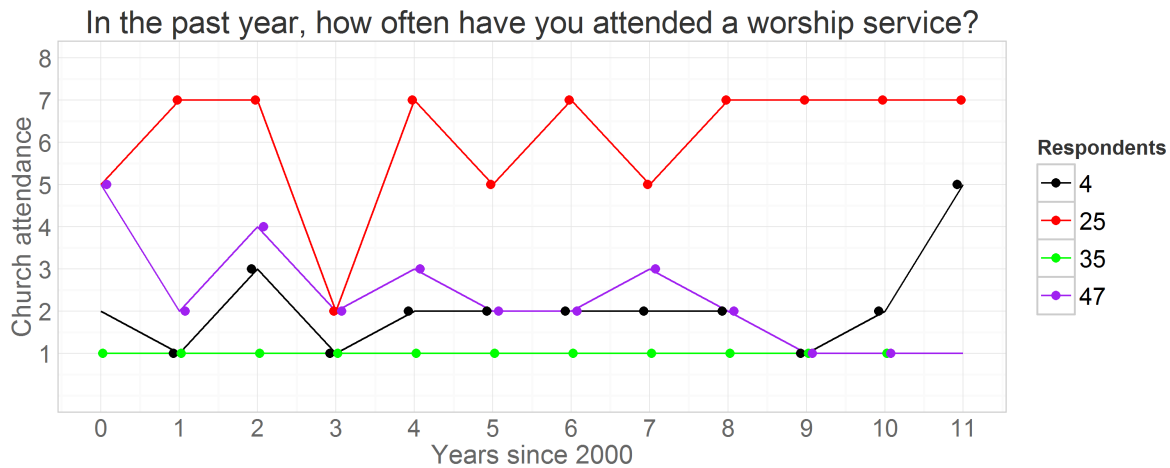
```
[1] 8983
```

subjects in total. Unless specified otherwise, only individuals from the cross-sample will be used in the model to increase external validity.

```
ds<- dsL %>% dplyr::filter(sample==1)
```

Each of such trajectories imply a story, a life scenario. Why one person grows in his religious involvement, while other declines, or never develops an interest in the first place? To demonstrate how interpretations of trajectories can vary among individuals consider the following scenario.

Attendance trajectories of subjects with **ids** 4, 25, 35, and 47 are plotted in the next graph



The respondent **id=35** reported attending no worship services in any of the years, while respondent **id=25** seemed to frequent it, indicating weekly attendance in 8 out of the 12 years. Individual **id=47** started as a fairly regular attendee of religious services in 2000 (5= “about twice a month”), then gradually declined his involvement to nil in 2009 and on. Respondent **id=4**, on the other hand started off with a rather passive involvement, reporting attended church only “Once or twice” in 2000, maintained a low level of participation throughout the years, only to surge his attendance in 2011. Latent curve models will describe intraindividual trajectories of change, while summarizing the interindividual similarities and trends.

Previous research in religiosity indicated that age might be one of the primary factors explaining interindividual differences in church attendance. To examine the role of age, we change the metric of time from waves of measurement, as in the previous graph, to biological age. There are, however, a number of ways information about age was recorded.

```
ds<- dsL %>% dplyr::filter(id %in% c(4,25,35,47),year %in% c(2000:2011)) %>%
  dplyr::select(idF,attend, year, byear, ageyear, agemon, ageyear) %>%
  mutate(time=year-2000, age=(year-byear+1), ageCurrent = agemon/12)
print(ds[ds$idF==25,])
```

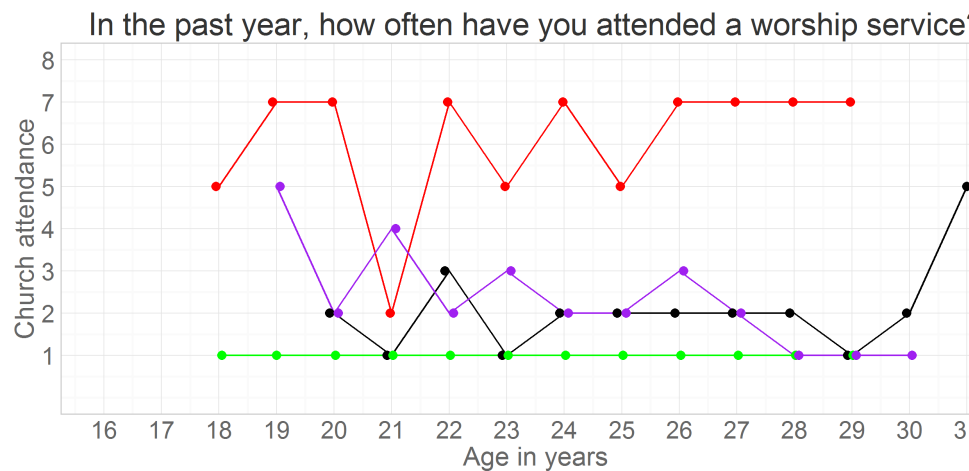
	idF	attend	year	byear	ageyear	agemon	time	age	ageCurrent
13	25	5	2000	1983	17	214	0	18	17.83
14	25	7	2001	1983	18	226	1	19	18.83
15	25	7	2002	1983	19	236	2	20	19.67
16	25	2	2003	1983	21	254	3	21	21.17
17	25	7	2004	1983	21	261	4	22	21.75
18	25	5	2005	1983	22	272	5	23	22.67
19	25	7	2006	1983	23	284	6	24	23.67
20	25	5	2007	1983	24	295	7	25	24.58
21	25	7	2008	1983	25	307	8	26	25.58
22	25	7	2009	1983	26	319	9	27	26.58
23	25	7	2010	1983	27	332	10	28	27.67
24	25	7	2011	1983	28	342	11	29	28.50

ds

	idF	attend	year	byear	ageyear	agemon	time	age	ageCurrent
1	4	2	2000	1981	19	238	0	20	19.83
2	4	1	2001	1981	20	251	1	21	20.92

3	4	3	2002	1981	21	262	2	22	21.83
4	4	1	2003	1981	22	276	3	23	23.00
5	4	2	2004	1981	23	287	4	24	23.92
6	4	2	2005	1981	24	297	5	25	24.75
7	4	2	2006	1981	25	309	6	26	25.75
8	4	2	2007	1981	26	320	7	27	26.67
9	4	2	2008	1981	27	336	8	28	28.00
10	4	1	2009	1981	28	344	9	29	28.67
11	4	2	2010	1981	29	357	10	30	29.75
12	4	5	2011	1981	30	368	11	31	30.67
13	25	5	2000	1983	17	214	0	18	17.83
14	25	7	2001	1983	18	226	1	19	18.83
15	25	7	2002	1983	19	236	2	20	19.67
16	25	2	2003	1983	21	254	3	21	21.17
17	25	7	2004	1983	21	261	4	22	21.75
18	25	5	2005	1983	22	272	5	23	22.67
19	25	7	2006	1983	23	284	6	24	23.67
20	25	5	2007	1983	24	295	7	25	24.58
21	25	7	2008	1983	25	307	8	26	25.58
22	25	7	2009	1983	26	319	9	27	26.58
23	25	7	2010	1983	27	332	10	28	27.67
24	25	7	2011	1983	28	342	11	29	28.50
25	35	1	2000	1983	17	216	0	18	18.00
26	35	1	2001	1983	18	227	1	19	18.92
27	35	1	2002	1983	19	239	2	20	19.92
28	35	1	2003	1983	20	250	3	21	20.83
29	35	1	2004	1983	21	264	4	22	22.00
30	35	1	2005	1983	22	274	5	23	22.83
31	35	1	2006	1983	23	286	6	24	23.83
32	35	1	2007	1983	24	297	7	25	24.75
33	35	1	2008	1983	25	310	8	26	25.83
34	35	1	2009	1983	26	320	9	27	26.67
35	35	1	2010	1983	27	334	10	28	27.83
36	35	1	2011	1983	28	345	11	29	28.75
37	47	5	2000	1982	18	220	0	19	18.33
38	47	2	2001	1982	19	233	1	20	19.42
39	47	4	2002	1982	20	243	2	21	20.25
40	47	2	2003	1982	21	257	3	22	21.42
41	47	3	2004	1982	22	266	4	23	22.17
42	47	2	2005	1982	23	280	5	24	23.33
43	47	2	2006	1982	24	292	6	25	24.33
44	47	3	2007	1982	25	302	7	26	25.17
45	47	2	2008	1982	26	315	8	27	26.25
46	47	1	2009	1982	27	326	9	28	27.17
47	47	1	2010	1982	28	339	10	29	28.25
48	47	1	2011	1982	29	351	11	30	29.25

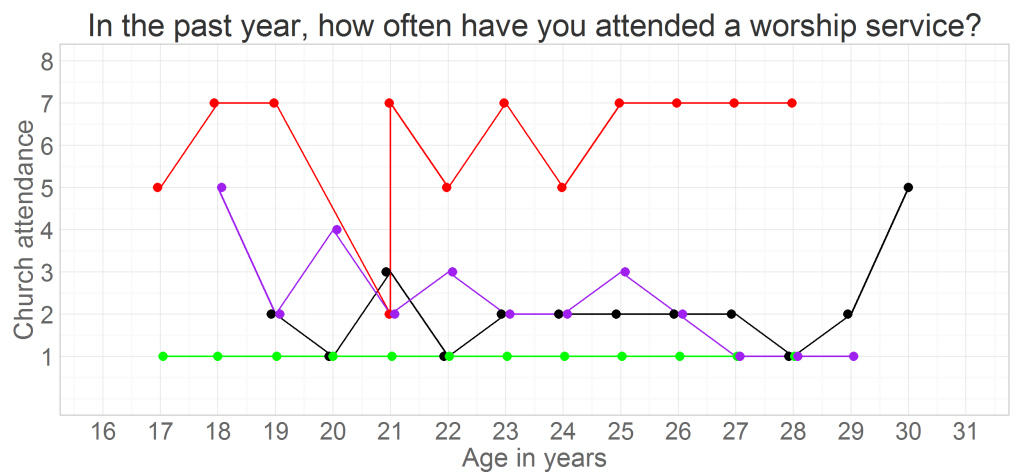
Note that for person **id** = 25 the age was recorded as 21 years for both 2003 and 2004. However, when you examine age in months (**agemon**) you can see this is rounding issue that disappears once a more precise scale is used. To avoid this potentially confusing peculiarity, age in years will be either calculated as (**age** = **year** - **byear** + 1)



Plotting age, caculated as age = year - byear + 1

```
ds<- dsL %>% dplyr::filter(id %in% c(4,25,35,47),year %in% c(2000:2011)) %>%
  dplyr::select(idF,year,attend,agemon,ageyear) %>%
  mutate(time=year-2000, age=ageyear)
head(ds,12)
```

	idF	year	attend	agemon	ageyear	time	age
1	4	2000	2	238	19	0	19
2	4	2001	1	251	20	1	20
3	4	2002	3	262	21	2	21
4	4	2003	1	276	22	3	22
5	4	2004	2	287	23	4	23
6	4	2005	2	297	24	5	24
7	4	2006	2	309	25	6	25
8	4	2007	2	320	26	7	26
9	4	2008	2	336	27	8	27
10	4	2009	1	344	28	9	28
11	4	2010	2	357	29	10	29
12	4	2011	5	368	30	11	30



Plotting age, caculated as age = ageyear

Plotting age, caculated as age = agemon/12

```
ds<- dsL %>% dplyr::filter(id %in% c(4,25,35,47),year %in% c(2000:2011)) %>%
  dplyr::select(idF,year,attend,agemon,ageyear,byear,time) %>%
  mutate(time=year-2000, age=agemon/12)
head(ds,12)
```

	idF	year	attend	agemon	ageyear	byear	time	age
1	4	2000	2	238	19	1981	0	19.83
2	4	2001	1	251	20	1981	1	20.92
3	4	2002	3	262	21	1981	2	21.83
4	4	2003	1	276	22	1981	3	23.00
5	4	2004	2	287	23	1981	4	23.92
6	4	2005	2	297	24	1981	5	24.75
7	4	2006	2	309	25	1981	6	25.75
8	4	2007	2	320	26	1981	7	26.67
9	4	2008	2	336	27	1981	8	28.00
10	4	2009	1	344	28	1981	9	28.67
11	4	2010	2	357	29	1981	10	29.75
12	4	2011	5	368	30	1981	11	30.67

