Homework 4

Denis Ostroushko

Question 1

1 - A

Figure 1 shows desired plot. For a small number of clusters, the trend appears to be similar for a small number of them.

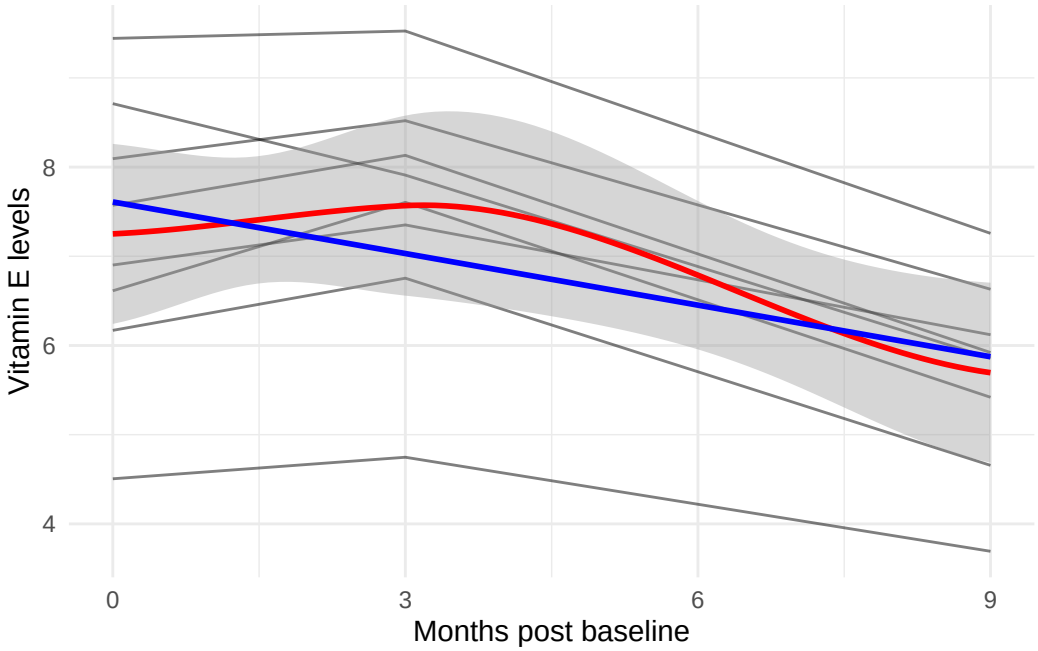

Figure 1: Individual Trends with the population average linear and smooth trends

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	7.61	0.42	18.18	0.00
timemonths	-0.19	0.08	-2.52	0.02

1 - B

For each additional follow up visit we saw an average 0.19 decrease in the Vitamin E μg/dl levels. Standard error is 0.08. Effect is bounded by a (-0.35, -0.03) 95% confidence interval, interval does not include 0, there is strong evidence of a statistically significant association between three months of additional time and vitamin E levels.

1 - C

	Estimate	Std. Error	t value
(Intercept)	7.61	0.49	15.51
timemonths	-0.19	0.03	-5.65

For each additional follow up visit we saw an average 0.19 decrease in the Vitamin E level in μg/dl levels. Standard error is 0.03. Effect is bounded by a (-0.26, -0.12) 95% confidence interval. There is strong statistical evidence that for the average subject, as the amount of time since baseline increases, expected Vitamin E levels levels decrease.

1 - D

Time since baseline is a cluster varying covariate. Failing to account for an existing correlation structure leads to an inflated standard errors, higher p-values, and wider confidence intervals. We end up performing conservative statistical inference, which may prevent us from discovering a statistically significant fixed effect.

1 - E

Variance between subjects is 1.65, and variance within subjects, within individual clusters, is 0.39. This means that there is much more differences between clusters, rather than the difference between the cluster specific average and observed data points.

This means that using Random Effects model is the right choice since subject specific random intercept helps us account for the majority of variance in the data set. We saw visual hits of this conclusion on Figure 1.

1 - F

	Estimate	Std. Error	t value
(Intercept)	7.61	0.55	13.77
timemonths	-0.19	0.04	-5.32

For each additional follow up visit we saw an average 0.19 decrease in the Vitamin E level in μg/dl levels. Standard error is 0.04. Effect is bounded by a (-0.27, -0.12) 95% confidence interval. There is strong statistical evidence that for the average subject, as the amount of time since baseline increases, expected Vitamin E levels levels decrease.

1 - G

- Null Hypothesis: $\mu_{ij} = \mathbf{x}_{ij}^T\beta + \mathbf{b}_i$
  - where b_i represents individual random intercept
- Alternative Hypothesis: $\mu_{ij} = \mathbf{x}_{ij}^T\beta + \mathbf{b}_i + \mathbf{c}_i * \mathbf{z}_{ij}$
  - c_i represents individual random slope effect
- Test Statistic: 1.8
- Null distribution: a mixture distribution $\chi^2_{1:2}$
- P-value: 0.0898
- Conclusion: p-value is greater that 0.05, which does not provide us with enough statistical evidence to reject null hypothesis and conclude that the variance of random slope term is not zero.
- Interpretation: Figure 1 shows that the profiles of clusters, and their trends, are similar. Therefore, it might not be reasonable to fit individual lines with varying slopes for each cluster, since it does not hep us explain more variance in the data set. Statistical test confirms that it might not be reasonable to fit a more complex model.

Question 2

2 - A

2 - A - (i)

```
Estimate    Std.err         Wald  Pr(>|W|)
```

```
(Intercept)  2.155157011 0.16496255 1.706818e+02 0.0000000
visit       -0.008417732 0.04127281 4.159701e-02 0.8383899
trt          0.011346273 0.27809652 1.664621e-03 0.9674555
visit:trt   -0.035089034 0.05217682 4.522594e-01 0.5012640
```

2 - A - (ii)

	Exp. Coefficient	95% CI	Wald	Pr(>|W|)
(Intercept)	8.6	(6.25, 11.92)	170.68	0.00
visit	1.0	(0.91, 1.08)	0.04	0.84
trt	1.0	(0.59, 1.74)	0.00	0.97
visit:trt	1.0	(0.87, 1.07)	0.45	0.50

2 - A - (iii)

2 - B

2 - B - (i)

2 - B - (ii)

	Exp. Coefficient	95% CI	Z	Pr(>|W|)
(Intercept)	6.2	(4.43, 8.56)	10.82	0.00
visit	1.0	(0.95, 1.03)	-0.41	0.68
trt	0.9	(0.56, 1.4)	-0.51	0.61
visit:trt	1.0	(0.91, 1.02)	-1.22	0.22

2 - B - (iii)

2 - C

2 - D

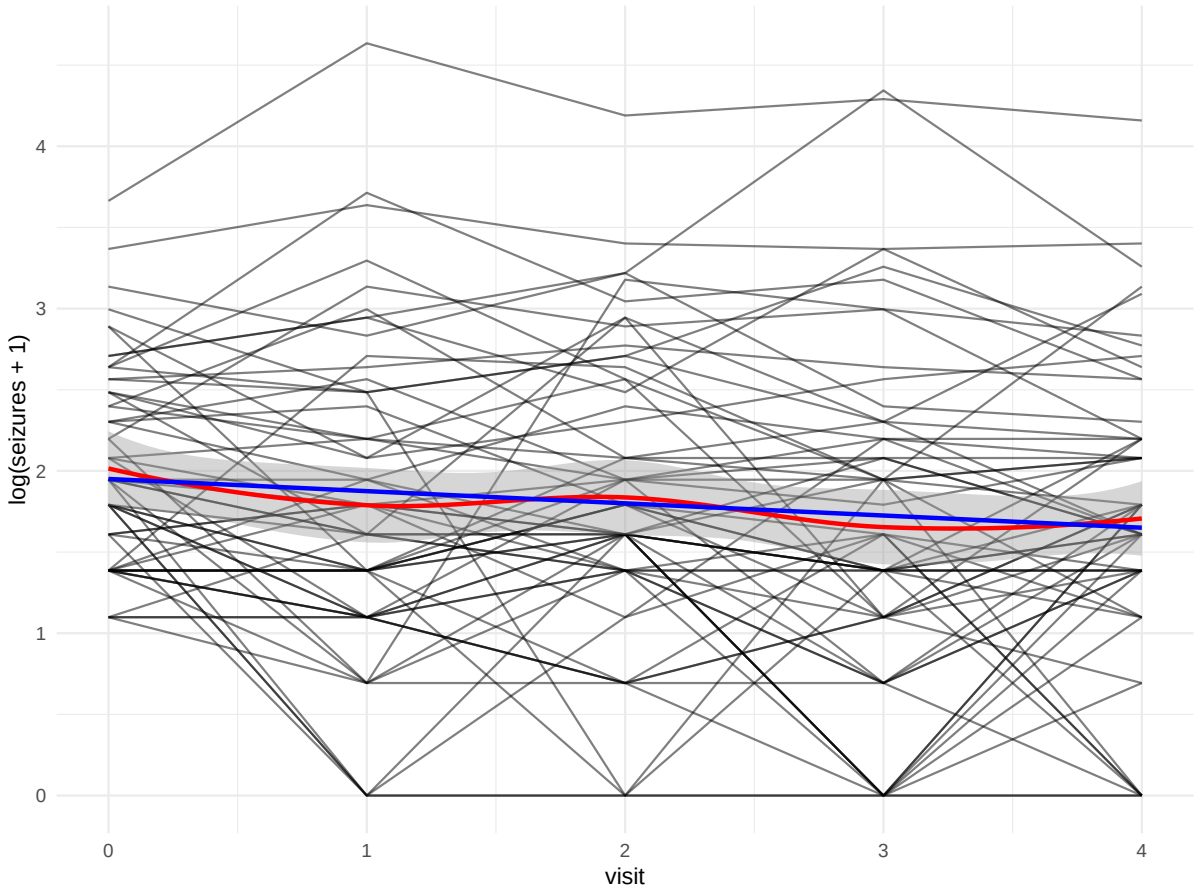

Figure 2: Individual Trends with the population average linear and smooth trends

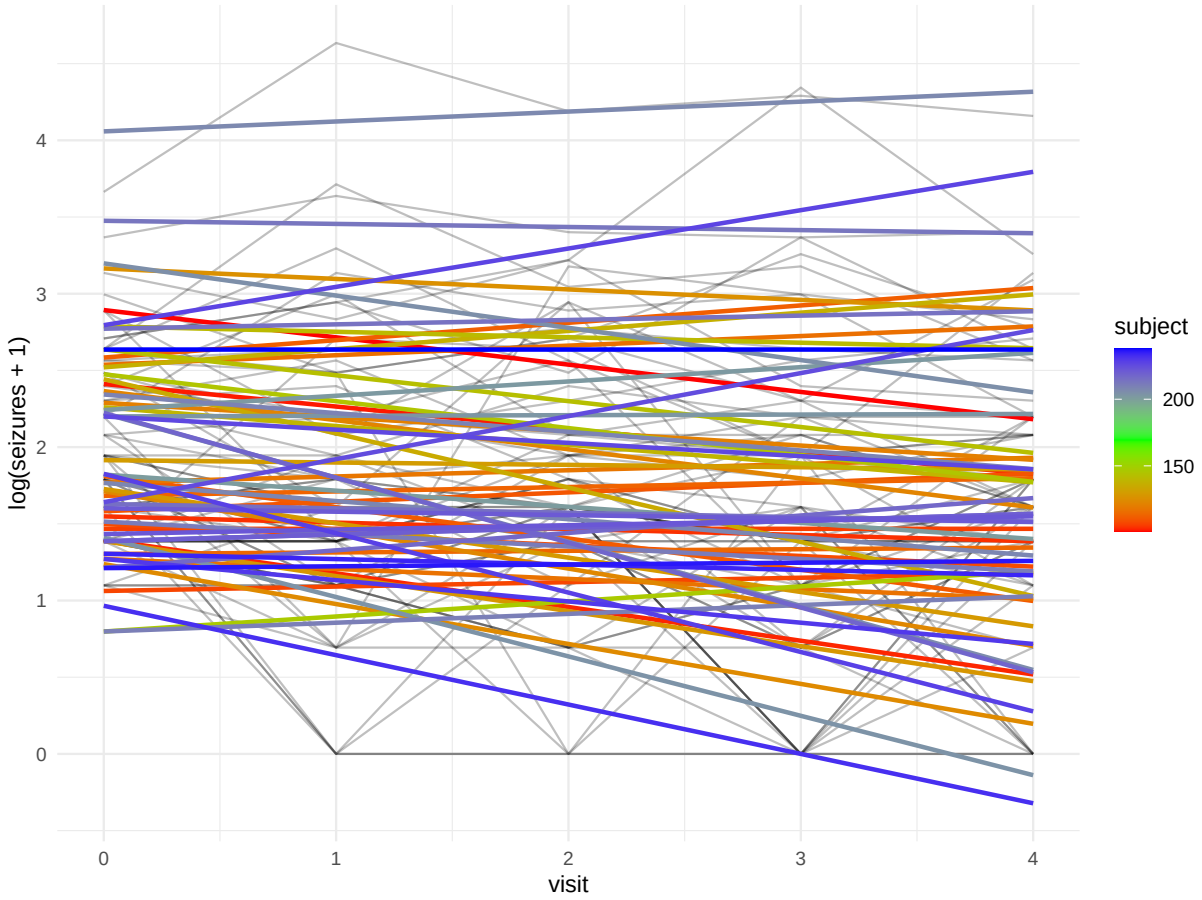

Figure 3: Individual Trends with the population average linear and smooth trends

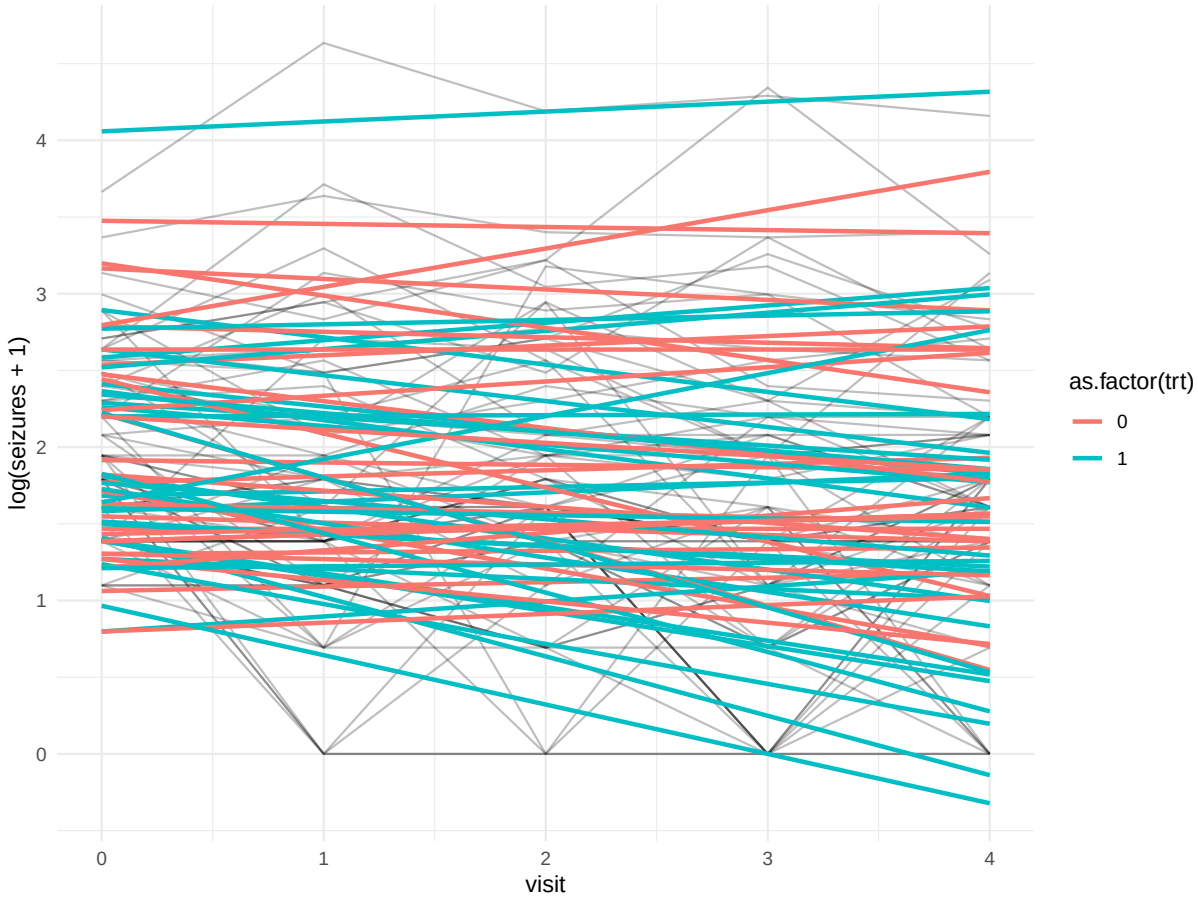

Figure 4: Individual Trends with the population average linear and smooth trends

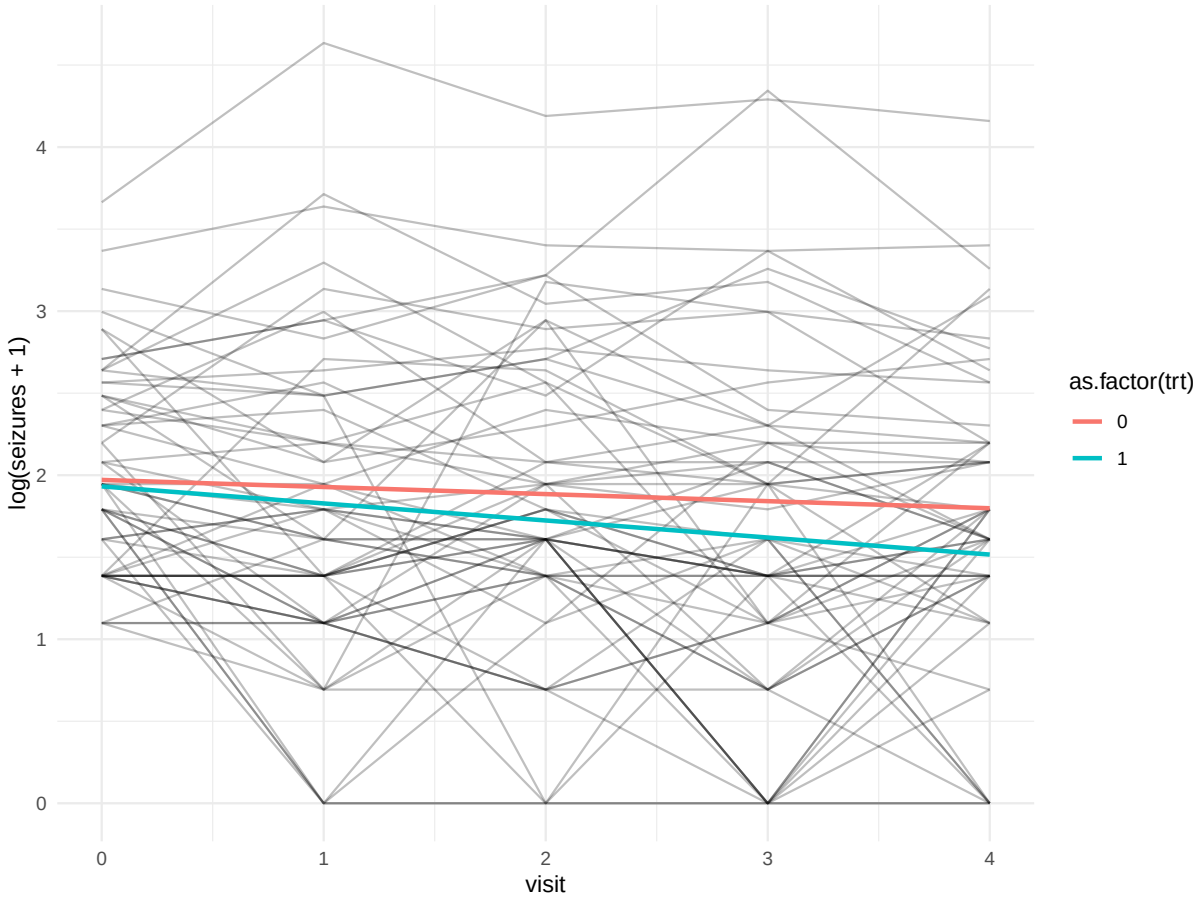

Figure 5: Individual Trends with the population average linear and smooth trends