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# Identifying School Climate Variables Associated with Students' Financial Literacy Outcomes

*A Cross-Country Comparison  
Using PISA 2018 Data*

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Master of Science (Assessment, Measurement and Evaluation)  
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敬致父母

To my parents

*Study hard what interests you the most in the  
most undisciplined, irreverent and original manner  
possible.*

*Richard P. Feynman*

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# Acknowledgement

Thank-you goes to



# Popular Abstract

Preparing youth for life-long success with numeracy, literacy and science capability has been the foundation for all schooling. The post-global financial crises and post-COVID era, in addition, imposes increasing demand on financial literacy for school leavers. Since 2012, OECD has been a pioneer in measuring 15-year-olds' financial literacy through its triennial Programme for International Student Assessment (PISA) cycles. Subsequent analyses using PISA data, however, reported paradoxical results that more classroom interventions tend to be associated with either no differences or even lower scores in students' financial literacy measures. It is in educators' interest therefore to carefully examine the relationship between school climate variables, including the academic, safety, community and institutional environment aspects of students' lives, and their financial literacy outcomes.

[Project summary]

The motivation for this project originates from my confusion over the current stock of literature, which states that school efforts do not matter, even harmful, in bringing about students' financial literacy while homes are better suited for this purpose. This claim is worrisome because if school are committing something wrong, school leaders and policy makers genuinely want to know what, which and where so that harmful pedagogies can be reverted into good practices. Alternatively, it could also be the measurement instrument researchers employed so far that led to such underwhelming results. A closer examination of how school effectiveness is measured would also promote research practice and the resultant policy advice.

Using 2018 PISA financial literacy data, including all 20 participating countries, I was able to examine how school climate variables, namely ACADEMIC, SAFETY, COMMUNITY and INSTITUTIONAL ENVIRONMENT each explained the total variation in students' financial literacy outcomes. Using a multilevel SEM with students' finance-related affective variables as mediators, my random intercept model shows that schools' academic practices do matter in advancing students' financial literacy outcomes but only through affective pathways. Cognitive pathways, however, were shown to correlate negatively with financial literacy scores. Since schools' cognitive and affective pathways are similar in size but opposite in signs, combining the two into total effects would have inadvertently resulted in the nonfindings as reported

by prior literature. In addition to this methodological insight, countries that overly focused on accountability through standard testing, tracking and measuring students' financial skills (e.g., the USA) fell prey to this cognitive trap while countries that placed more emphases on cultivating students' affective affinity such as confidence in, and familiarity with, financial matters (e.g., Finland) delivered impressive education outcome in financial literacy.



# Abstract

Repeated economic crises in recent memory have exposed the harsh consequences of financial *illiteracy* shared by high proportions of the general population. Policy makers experienced little resistance when identifying youth as the most effective group for bringing about improvement in citizens' ability to engage with economic and financial matters, but opinions quickly diverge over the optimal approaches for achieving such targeted outcome. Existing literature frequently reports the importance of family environment in cultivating students' financial literacy through the process of "financial socialisation" – [definition goes here] (reference). Such practice, however, encounters interrogation by educators over equity concerns should families remain the main arena for financial literacy development. Schools play vital roles in alleviating inequality in accessing education and training in general but scarce research so far has been devoted into identifying the specific classroom factors that are most effective in advancing students' financial literacy outcomes. The current study therefore attempts to contribute to this enquiry by investigating the relationship between school climate variables and students' financial literacy achievement with an aim of stimulating policy debate about the levers and instruments available to education interventionists for the purpose of improving young people's financial literacy and preparedness as they step into an increasingly uncertain world. Using the 2018 PISA dataset, this paper employs a three-level hierarchical model to conduct cross-country comparisons to highlight school climate variables that are most strongly associated with high financial literacy outcomes.



# Chapter 1 Introduction

Repeated economic crises in recent memory have exposed the harsh consequences of financial *illiteracy* shared by high proportions of the general population. Low levels of financial literacy are observed not only in less developed countries such as India and Indonesia (Cole et al., 2009) but also in advanced economies such as the USA (Huston, 2012), Germany (bucherkoenen:2016) and OECD countries (Lusardi, 2015). Amongst the many redress schemes aimed at promoting citizens' financial capability, the return on investment is the highest when intervention is applied early in life. Lusardi and Mitchell (2014) have shown that providing financial knowledge to the least educated before they enter the labour market increases their well-being by approximately 82% of their initial wealth, while the rate of return is around 56% for college graduates—results that are significant both statistically and economically.

Research efforts aiming at advancing youth's financial literacy over the years evolved into two strands: on the design and evaluation of school financial education programs, and on the influence of home environment through the process of financial socialisation—the intentional or involuntary transmission of financial concepts which are required to functioning successfully in society (Bowen, 2002). A recent meta-analysis conducted by Kaiser and Menkhoff (2020) found that while school financial education programs had sizeable impacts on *financial knowledge* (+0.33 *SD*) similar to education interventions in other domains, their effect on students' *financial behaviour* is quite small (+0.07 *SD*). This conclusion added to a list of weak or non-findings regarding the long-term behavioural effect brought about by school financial education programs. Brown et al. (2016), for instance, reported mixed outcome in students' long-term financial well-being depending on the programs received; whereas Cole et al. (2016) observed that traditional personal finance courses lacked any explanatory power in accounting for graduates' financial outcome once the additional mathematics training in which finance topics were packaged has been controlled for. Despite careful controls and thoughtful study designs, correlating classroom interventions and young people's financial literacy outcomes has repeatedly yielded paradoxical results of non-significant or even negative relationship; any positive findings remain small in magnitudes and/or are sensitive to robust analyses.

Optimism, fortunately, runs higher at the financial socialisation camp. Building on the

acknowledgement that families serve as information filters from the outside world (Danes & Haberman, 2007) as well as the foundation for youth's continued financial concept formation, Gudmunson and Danes (2011) put forward a family financial socialisation theory to accommodate both the *process* and the *outcome* for variations in young people's financial capabilities. Using structural equation modelling, Jorgensen and Savla (2010) was able to show that perceived parental influence had a direct and moderately significant influence on financial attitude, did *not* have an effect on *financial knowledge*, and had an indirect and moderately significant influence on financial behaviour, mediated through financial attitude. This attitude(A)–behaviour(B)–cognition(C) conceptualisation of financial literacy (Potrich et al., 2015) continues to influence subsequent research effort. More recently, Moreno-Herrero et al. (2018) continued this line of enquiry by applying multilevel regression analyses to 2015 PISA data and reported that students' financial literacy was associated mainly with understanding the value of saving and discussing money matters with parents. In addition, exposure and use of financial products, in particular holding a bank account, improved students' financial knowledge as well.

One chief concern for every research project is the quality of its data source. Amongst competing inventories, PISA stands out as a comprehensive and reliable source of data for measuring 15-year-olds' financial literacy outcomes thanks to OECD's careful sampling procedure and attention to construct validity of measurement. Following statistical theory, PISA designers firstly recognise the hierarchical nature of education research data such that students are nested in schools, and schools are further nested in countries. In addition, one student weight is assigned to each observation in order to account for the fact that not all schools in a country are equally likely to be sampled by the PISA organiser; and given a particular school that has been chosen, not every student in this school is equally likely to be asked to participate in the test (Rust, 2014). A third complication arises from the "planned missingness" in students' responses because each participant is only given a small number of questions relative to the entire test bank in order to ensure their responses are not undermined by tiredness (von Davier, 2014), leading to the outcome variables being represented by ten plausible values. Lastly, PISA consulted and synthesised multiple schools of thoughts (OECD, 2019) before constructing financial literacy as

the knowledge and understanding of financial concepts and risks, and the skills, motivation and confidence to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the

financial well-being of individuals and society, and to enable participation in economic life. (p. 128)

As a result, 2018 PISA data set (OECD, [2020](#)) provides not only variables measuring *cognitive* outcomes but also *affective* factors such as familiarity with concepts of finance and confidence about financial matters, enabling a nuanced study design involving decomposing the total effect of financial literacy development into its “brain” (cognitive) and “heart” (affective) pathways.

The current study wishes to take advantage of the latest wave of 2018 PISA results and investigate the covariation financial literacy outcomes share with the following four aspects of young people’s daily lives, inspired by school climate literature (Wang & Degol, [2016](#)):

(a) academic training, including any financial education programs received at schools; (b) safety perception about their schools; (c) financial socialisation experienced at home; and (d) their schools’ resource endowment. More specifically, this project aims to answer these three research questions:

- RQ1. Having controlled for demographic characteristics such as socio-economic status, sex and immigration history, to what extent can the variation in students’ financial literacy outcomes be accounted for by each of the school climate variables mentioned above.
- RQ2. How does the total effect each school climate variable carries decompose into cognitive and affect pathways.
- RQ3. How do these effects differ across countries.



# Chapter 2 Conceptual Framework

## 2.1 In-depth definitions of “financial literacy”

2.1.1 Every term my readers need in order to understand my research question

2.1.2 Survey not only PISA but also alternative definitions, even critiques of such definitions

2.1.3 Any practices that are common in maths/literature but uncommon in financial literacy? Meaning? Implies?

## 2.2 Country-level Financial Knowledge Index

PISA 2018 financial literacy dataset (OECD, 2020) provides rich information about students and schools. For the purpose of cross-country comparison, however, the country-level financial literacy information must be addressed separately by the researchers. Earlier attempts such as Moreno-Herrero et al. (2018) approximated this information using a variable “quality of math and science education” to control for country-level differences since consensus is yet to emerge about the most appropriate measure for countries’ financial knowledge. Inspired by the UN’s approach to forming Human Development Indices, a recent publication by Oliver-Márquez et al. (2020) proposed a macroeconomic measure for countries’ general financial knowledge levels by examining their economic capability, educational training, existing practices in the financial markets as well as incentives to interact with financial products. More specifically, the authors considered a country’s economic capability, represented by its GDP per capita, to be a key dimension in bringing about its financial knowledge index (FKI). Secondly, literature converges on the importance of educational training for a country’s financial knowledge capability (OECD, 2005). Thirdly, countries with regular engagement with sophisticated financial products and financial markets should possess higher FKI. Lastly, countries with higher aggregate consumption levels and with ageing populations are likely to possess higher FKI due to more frequent exposure and pressure in retirement provision, respectively. Macroeconomic data needed for these computations can be sourced from the World Bank (World Bank, 2020) and the United Nations’ *Human Development Reports* (United Nations, 2020).

Combining individual and institutional data sources can be a productive approach in international large-scale assessment (ILSA) research. According to the framework for comparative education analyses (Bray & Thomas, 1995), this project extends education outcome measures to a country level, addresses the aspect of society and labour market, and relates countries’ entire populations to ILSA research (Strietholt & Scherer, 2018). By combining education outcome data with countries’ economic performance indicators, this project remains most comparable to Hanushek and Woessmann (2012)—while these authors looked into the relationship between countries’ education achievement and their GDP growth, the current investigation highlights how countries’ GDP, along with other macroeconomic practices, in turn systematically impacts on their youth’s educational performance.



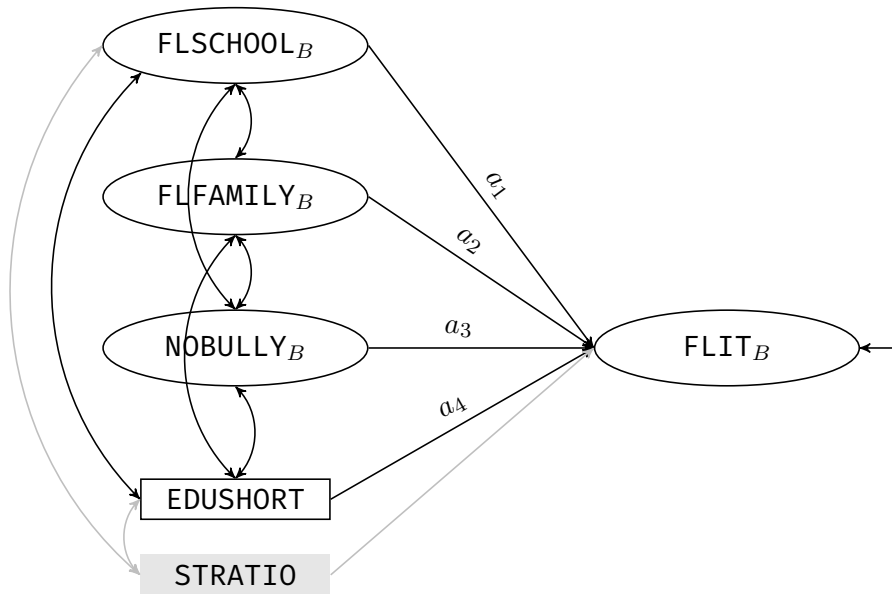
**Table 2.1**  
*Percentages of Missing Values*

CNT	MALE	IMMI1GEN	IMMI2GEN	ESCS	FCFMLRTY	FLCONFIN	PERFEED	TEACHINT	FLSCH00L	DISCRIM <sup>†</sup>	BELONG	BULLY	FLFAMILY	CURSUPP <sup>†</sup>	PASCHPOL <sup>†</sup>	STRATIO	EDUSHT	STAFFSHT
BGR	0	6	6	3	12	27	10	10	21	28	19	31	22	100	100	8	3	3
BRA	0	5	5	2	12	34	9	8	21	36	23	40	24	17	19	12	6	7
CAN <sup>†</sup>	0	7	7	5	11	15	100	100	13	100	8	14	14	100	100	100	2	2
CHL	0	4	4	3	10	24	5	4	13	30	15	34	15	9	8	18	9	9
ESP	0	3	3	2	5	21	3	2	7	25	9	29	8	100	100	11	5	6
EST	0	3	3	3	4	8	3	3	6	9	5	11	6	100	100	0	0	0
FIN	0	2	2	2	4	10	3	3	6	100	6	11	7	100	100	2	7	7
GEO	0	5	5	2	9	26	9	9	17	100	15	22	21	4	5	1	2	2
IDN	0	3	3	1	3	6	3	2	5	3	2	5	5	100	100	23	14	14
ITA	0	4	4	3	7	17	4	4	10	23	10	27	12	16	17	9	3	3
LTU	0	3	3	3	4	12	3	3	5	17	8	20	7	100	100	0	0	0
LVA	0	2	2	2	5	9	3	3	6	14	6	15	7	100	100	6	3	4
NLD	0	3	3	2	3	5	3	2	4	100	4	8	4	100	100	11	5	5
PER	0	2	2	1	2	11	5	4	4	56	31	65	5	100	100	2	0	0
POL	0	1	1	1	3	7	2	1	5	9	3	11	5	100	100	0	0	0
PRT	0	6	6	5	8	11	6	6	10	15	8	17	10	10	10	11	1	1
RUS	0	3	3	2	8	13	5	4	11	13	8	15	11	100	100	3	3	3
SRB	0	3	3	1	10	25	8	7	18	25	15	27	19	100	100	8	1	1
SVK	0	2	2	1	4	12	4	3	7	14	6	17	8	100	100	6	6	7
USA	0	3	3	2	3	6	2	1	4	100	4	6	4	100	100	16	10	10

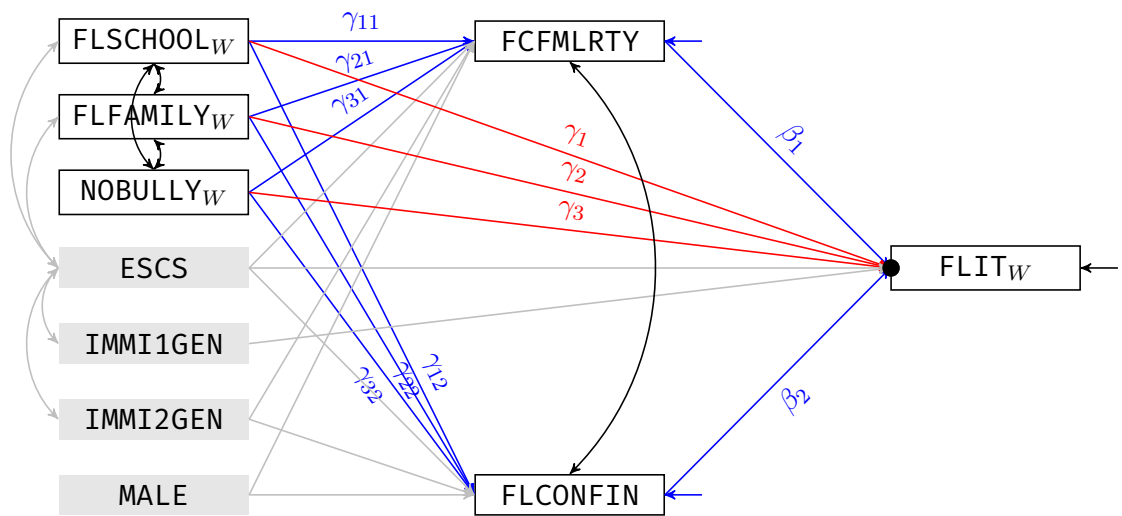
*Note.* Using shades of red in addition to numbers (measured in %), this table visualises the missing percentages by variable and by country. Variables **DISCRIM**, **CURSUPP** and **PASCHPOL** are no longer pursued in the model because too many countries chose not to respond to these questions. Canada (CAN) is not included due to 100 percent missings on multiple variables. <sup>†</sup> marks the country and variables that are excluded from subsequent analyses.

**Figure 2.1**  
Path Diagram

**L2: School**



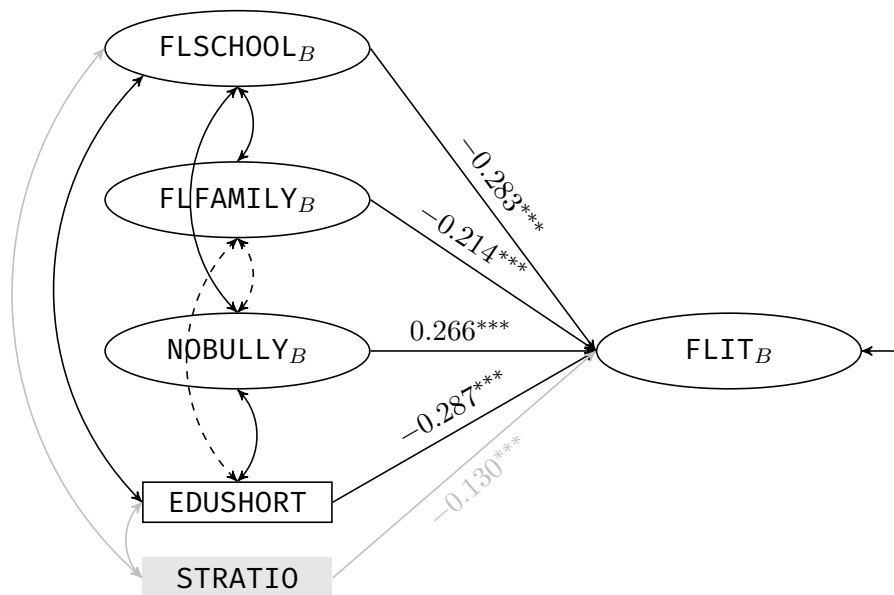
**L1: Student**



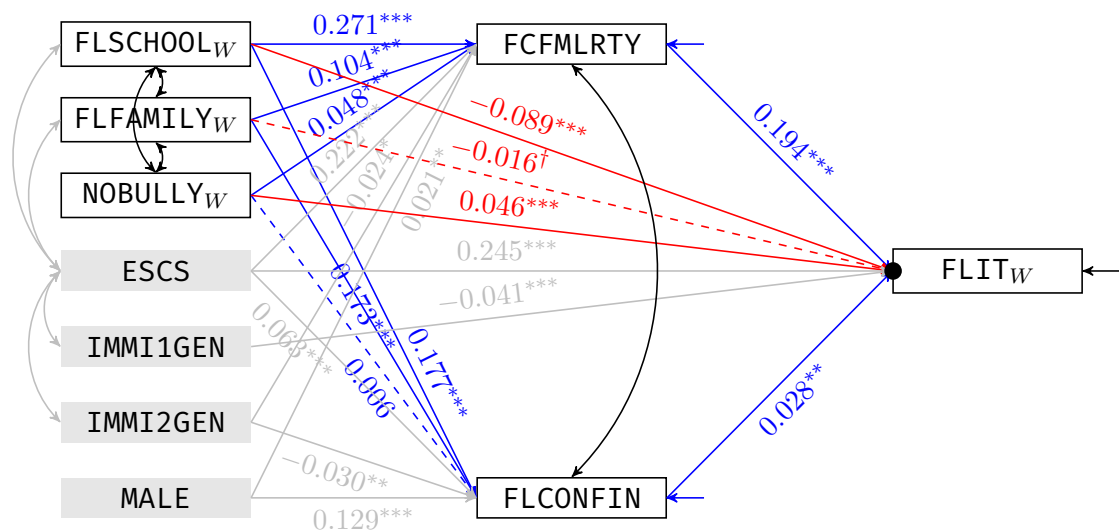
Note. [Insert notes here.]

**Figure 2.2**  
Path Diagram

**L2: School**



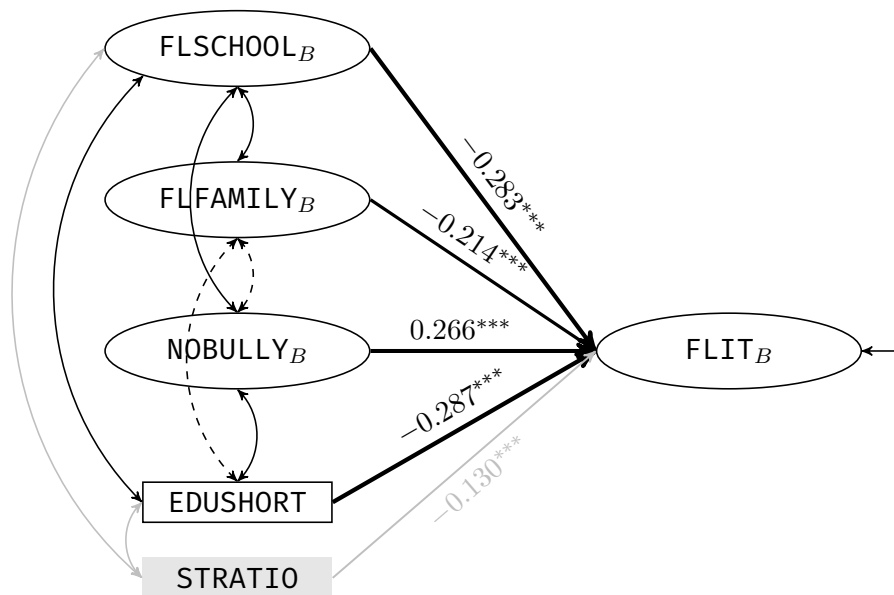
**L1: Student**



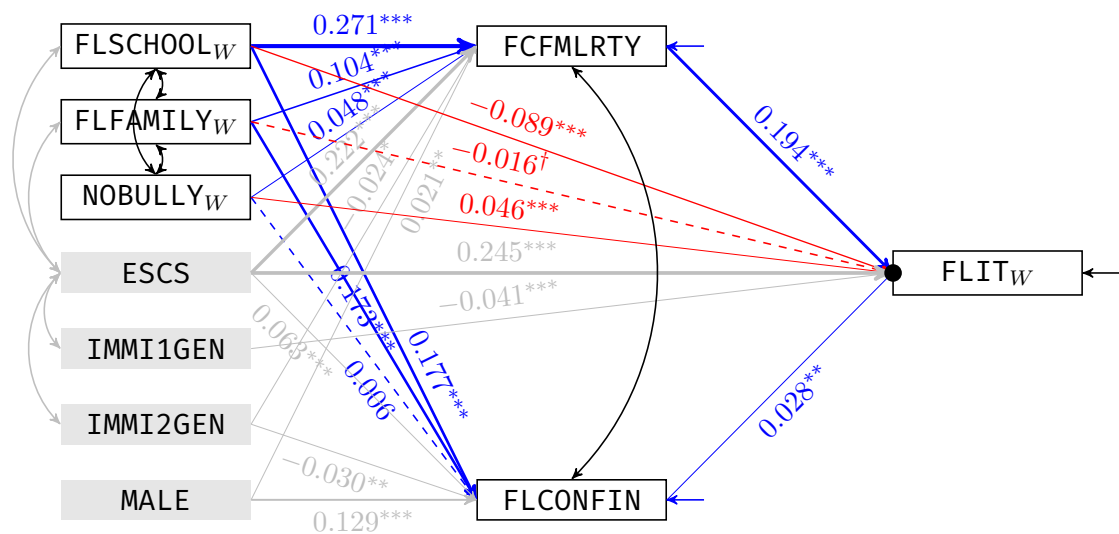
Note. [Insert notes here.]

**Figure 2.3**  
Path Diagram

**L2: School**



**L1: Student**



Note. [Insert notes here.]

# Chapter 3 Methods

## 3.1 Sample

This study drew its primary data source from OECD’s PISA 2018 database (OECD, 2020). Responses from both student and school questionnaires were captured and merged into a master data file using R’s (R Core Team, 2021) `intsvy` package (Caro & Biecek, 2017). The following 20 countries<sup>1</sup> participated in the optional financial literacy section in the 2018 PISA cycle: Brazil, Bulgaria, Canada, Chile, Estonia, Finland, Georgia, Indonesia, Italy, Latvia, Lithuania, the Netherlands, Peru, Poland, Portugal, Russian Federation, Serbia, Slovak Republic, Spain, and the USA. Due to clerical error concerns, twelve observations containing missing values in school-level weights were dropped, leading to a sample size of 107162 students and 6631 schools. Table A.1 further suggested that although all countries assembled balanced samples by student gender ( $\chi^2_{\text{GOF}} = 20.90, p = 0.34$ ), not all 20 countries contributed equally to the school ( $\chi^2_{\text{GOF}} = 1105.8, p < 0.001$ ) and student counts ( $\chi^2_{\text{GOF}} = 16984, p < 0.001$ ), ranging from almost 9% (Brazil and Spain, respectively) to as low as just over 2% (the Netherlands for both categories).

## 3.2 Measures

students were asked about their demographic background, family lives and school experiences. For the financial literacy section, in particular, students responded to questions about their familiarity with concepts of finance (FCFMLRTY), confidence about financial matters (FLCONFIN), their classroom (FLSCHOOL) as well as parental (FLFAMILY) involvement in matters of financial literacy. Ten plausible values were subsequently generated by PISA organisers as measures of students’ financial literacy outcomes and were used as the dependent variable (FLIT).

Student-level independent variables are

School-level independent variables are

---

<sup>1</sup>Australia also participated in 2018 PISA financial literacy but chose to withhold its data from public release and will therefore not be included in the current study.

### 3.2.1 Cognitive Measure of Financial Literacy

### 3.2.2 Affective Aspects of Financial Literacy

### 3.2.3 Demographic Variables

### 3.2.4 Reliability of Level-two Averages

## 3.3 Model

Student-level ( $L_1$ ):

$$\begin{aligned} \text{FCFMLRTY}_{ij} &= \alpha_j^{M_1} + \gamma_{11}\text{FLSCHOOL}_{ij} + \gamma_{21}\text{FLFAMILY}_{ij} + \gamma_{31}\text{NOBULLY}_{ij} \\ &\quad + \gamma_{41}\text{ESCS}_{ij} + \gamma_{61}\text{IMMI2GEN}_{ij} + \gamma_{71}\text{MALE}_{ij} + r_{ij}^{M_1} \\ \text{FLCONFIN}_{ij} &= \alpha_j^{M_2} + \gamma_{12}\text{FLSCHOOL}_{ij} + \gamma_{22}\text{FLFAMILY}_{ij} + \gamma_{32}\text{NOBULLY}_{ij} \\ &\quad + \gamma_{42}\text{ESCS}_{ij} + \gamma_{62}\text{IMMI2GEN}_{ij} + \gamma_{72}\text{MALE}_{ij} + r_{ij}^{M_2} \\ \text{FLIT}_{ij} &= \alpha_j^Y + \beta_1\text{FCFMLRTY}_{ij} + \beta_2\text{FLCONFIN}_{ij} \\ &\quad + \gamma_1\text{FLSCHOOL}_{ij} + \gamma_2\text{FLFAMILY}_{ij} + \gamma_3\text{NOBULLY}_{ij} \\ &\quad + \gamma_4\text{ESCS}_{ij} + \gamma_5\text{IMMI1GEN}_{ij} + r_{ij}^Y \end{aligned} \tag{3.1}$$

School-level ( $L_2$ ):

$$\begin{aligned} \alpha_j^Y &= \alpha_{00}^Y + a_1\text{FLSCHOOL}_j + a_2\text{NOBULLY}_j + a_3\text{FLFAMILY}_j + a_4\text{EDUSHTG}_j \\ &\quad + a_5\text{STRATIO}_j + \varepsilon_j^Y \end{aligned} \tag{3.2}$$

Using Kaplan's (2009) notation  $\mathbf{y}_{ij} = \boldsymbol{\alpha}_j + \mathbf{B}_j\mathbf{y}_{ij} + \boldsymbol{\Gamma}_j\mathbf{x}_{ij} + \mathbf{r}_{ij}$  for student-level ( $L_1$ )

and random intercept  $\alpha_j = \alpha_{00} + \mathbf{A}\mathbf{w}_j + \varepsilon_j$  for school-level ( $L_2$ ):

$$\begin{aligned}
\begin{bmatrix} \text{FCFMLRTY}_{ij} \\ \text{FLCONFIN}_{ij} \\ \text{FLIT}_{ij} \end{bmatrix} &= \begin{pmatrix} \alpha_j^{M_1} \\ \alpha_j^{M_2} \\ \alpha_j^{Y_W} \end{pmatrix} + \begin{pmatrix} 0 & 0 & \beta_1 \\ 0 & 0 & \beta_2 \\ 0 & 0 & 0 \end{pmatrix}^T \begin{bmatrix} \text{FCFMLRTY}_{ij} \\ \text{FLCONFIN}_{ij} \\ \text{FLIT}_{ij} \end{bmatrix} \\
&+ \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_1 \\ \gamma_{21} & \gamma_{22} & \gamma_2 \\ \gamma_{31} & \gamma_{32} & \gamma_3 \\ \gamma_{41} & \gamma_{42} & \gamma_4 \\ 0 & 0 & \gamma_5 \\ \gamma_{61} & \gamma_{62} & 0 \\ \gamma_{71} & \gamma_{72} & 0 \end{pmatrix}^T \begin{bmatrix} \text{FLSCHOOL}_{ij} \\ \text{FLFAMILY}_{ij} \\ \text{NOBULLY}_{ij} \\ \text{ESCS}_{ij} \\ \text{IMMI1GEN}_{ij} \\ \text{IMMI2GEN}_{ij} \\ \text{MALE}_{ij} \end{bmatrix} + \begin{pmatrix} r_{ij}^{M_1} \\ r_{ij}^{M_2} \\ r_{ij}^{Y_W} \end{pmatrix}, \quad (3.3) \\
\begin{pmatrix} \alpha_j^{M_1} \\ \alpha_j^{M_2} \\ \alpha_j^{Y_W} \end{pmatrix} &= \begin{pmatrix} \alpha_{00}^{M_1} \\ \alpha_{00}^{M_2} \\ \alpha_{00}^Y \end{pmatrix} + \begin{pmatrix} 0 & 0 & a_1 \\ 0 & 0 & a_2 \\ 0 & 0 & a_3 \\ 0 & 0 & a_4 \\ 0 & 0 & a_5 \end{pmatrix}^T \begin{bmatrix} \text{FLSCHOOL}_j \\ \text{NOBULLY}_j \\ \text{FLFAMILY}_j \\ \text{EDUSHTG}_j \\ \text{STRATIO}_j \end{bmatrix} + \begin{pmatrix} 0 \\ 0 \\ \varepsilon_j^{Y_B} \end{pmatrix}.
\end{aligned}$$

### 3.4 Missing Data Treatment

Missing data impose great potential for biased estimation. This study addressed the missing data issue through multilevel multiple imputation under the assumption that data were missing at random (Little & Rubin, 2019). Since 2018 PISA financial literacy datasets contain missing data in both student- and school-levels and in both continuous and categorical variables, the joint modelling approach is adopted under the advisory of Grund et al. (2018). More specifically, ten sets of imputed data were ordered through Mplus’s unrestricted variance-covariance model (“JM-AM H1”, Asparouhov & Muthén, 2010) using Bayes estimation procedure with uninformative priors and 4-chain Gibbs sampler to verify convergence (Lambert, 2018, p. 314). Additionally, the first 50000 MCMC iterations were discarded to ensure stability and any two draws were separated with 5000 iterations to avoid autocorrelation (see Section B.1 for input file)—a safe setting even for moderate to high percentage missings (Grund et al., 2016). Diagnostic plots in Section B.3 presented visual evidence for convergence with imputation

results summarised in [Table B.1](#).

## **3.5 Analysis**

### **3.5.1 Weights**

### **3.5.2 Plausible Values and Rubin's Rule**

## **3.6 Estimators**

## **3.7 Model Comparison**



# Chapter 4 Results

## 4.1 Descriptive statistics

## 4.2 Correlation matrices

### 4.2.1 Across countries

### 4.2.2 Across levels: Country | School | Students

## 4.3 Examination of measurement models

**Table 4.1***Model Parameters and Fit Indices for Multilevel Regressions*

Variable — path	Model parameter	Null Model Coef	Null Model SE	One-level Model Coef	One-level Model SE	Two-level Saturated Coef	Two-level Saturated SE	Two-level Structured Coef	Two-level Structured SE
<b>FIXED EFFECTS</b>									
Intercept		454.154	2.690***	451.451	1.449***	445.812	2.578***	486.820	4.500***
<b>Student-level Predictors</b>									
FLSCHOOL (total)	$\gamma_1 + \gamma_{11}\beta_1 + \gamma_{12}\beta_2$			-0.073	0.008***	-0.036	0.011**	-0.036	0.011**
— direct	$\gamma_1$			-0.125	0.008***	-0.088	0.011***	-0.088	0.011***
— total indirect	$\gamma_{11}\beta_1 + \gamma_{12}\beta_2$			0.051	0.003***	0.052	0.003***	0.052	0.003***
— via FCFMLRTY	$\gamma_{11}\beta_1$			0.049	0.002***	0.047	0.003***	0.047	0.003***
— via FLCONFIN	$\gamma_{12}\beta_2$			0.002	0.001	0.005	0.002**	0.005	0.002**
FLFAMILY (total)	$\gamma_2 + \gamma_{21}\beta_1 + \gamma_{22}\beta_2$			0.008	0.007	0.005	0.009	0.005	0.009
— direct	$\gamma_2$			-0.016	0.007*	-0.019	0.009*	-0.019	0.009*
— total indirect	$\gamma_{21}\beta_1 + \gamma_{22}\beta_2$			0.023	0.002***	0.024	0.002***	0.024	0.002***
— via FCFMLRTY	$\gamma_{21}\beta_1$			0.022	0.002***	0.019	0.002***	0.019	0.002***
— via FLCONFIN	$\gamma_{22}\beta_2$			0.002	0.001	0.005	0.002**	0.005	0.002***
NOBULLY (total)	$\gamma_3 + \gamma_{31}\beta_1 + \gamma_{32}\beta_2$			0.075	0.007***	0.053	0.009***	0.053	0.009***
— direct	$\gamma_3$			0.064	0.007***	0.046	0.009***	0.046	0.009***
— total indirect	$\gamma_{31}\beta_1 + \gamma_{32}\beta_2$			0.011	0.002***	0.007	0.002***	0.007	0.002***
— via FCFMLRTY	$\gamma_{31}\beta_1$			0.011	0.002***	0.007	0.002***	0.007	0.002***
— via FLCONFIN	$\gamma_{32}\beta_2$			0.000	0.000	0.000	0.000	0.000	0.000
ESCS (total)	$\gamma_4 + \gamma_{41}\beta_1 + \gamma_{42}\beta_2$			0.497	0.007***	0.289	0.016***	0.289	0.016***
— direct	$\gamma_4$			0.445	0.007***	0.248	0.015***	0.248	0.015***
— total indirect	$\gamma_{41}\beta_1 + \gamma_{42}\beta_2$			0.052	0.003***	0.041	0.003***	0.041	0.003***
— via FCFMLRTY	$\gamma_{41}\beta_1$			0.052	0.002***	0.040	0.003***	0.040	0.003***
— via FLCONFIN	$\gamma_{42}\beta_2$			0.001	0.001	0.001	0.001*	0.001	0.001*
IMMI1GEN (direct)	$\gamma_5$			0.004	0.008	-0.040	0.012**	-0.040	0.012**
IMMI2GEN (total indirect)	$\gamma_{61}\beta_1 + \gamma_{62}\beta_2$			-0.003	0.002†	-0.006	0.002**	-0.006	0.002**
— via FCFMLRTY	$\gamma_{61}\beta_1$			-0.003	0.002†	-0.005	0.002*	-0.005	0.002*
— via FLCONFIN	$\gamma_{62}\beta_2$			0.000	0.000	-0.001	0.000*	-0.001	0.000*
MALE (total indirect)	$\gamma_{71}\beta_1 + \gamma_{72}\beta_2$			0.004	0.002*	0.007	0.002**	0.007	0.002**
— via FCFMLRTY	$\gamma_{71}\beta_1$			0.003	0.002*	0.004	0.002*	0.004	0.002*
— via FLCONFIN	$\gamma_{72}\beta_2$			0.001	0.001	0.003	0.001**	0.003	0.001**

*Continued*

Variable	Model parameter	Null Model		One-level Model		Two-level Saturated		Two-level Structured	
		Coef	<i>SE</i>	Coef	<i>SE</i>	Coef	<i>SE</i>	Coef	<i>SE</i>
<b>School-level Predictors</b>									
FLSCHOOL	$a_1$							-0.295	0.066***
FLFAMILY	$a_2$							-0.225	0.057***
NOBULLY	$a_3$							0.233	0.069***
EDUSHORT	$a_4$							-0.292	0.038***
STRADIO	$a_5$							-0.132	0.026***
<b>RANDOM EFFECTS</b> (residual variances of FLIT)									
Student-level	$\text{var}(r_{ij}^Y)$	6121.904	131.192	7866.408	114.555	5763.677	130.133	5763.690	130.133
School-level	$\text{var}(\varepsilon_j^Y)$	5240.477	202.004			3264.618	193.892	1705.616	135.044
<b>MODEL FIT INDICES</b>		Est	<i>SD</i>	Est	<i>SD</i>	Est	<i>SD</i>	Est	<i>SD</i>
AIC		1253984	1093	3429058	1534	3468075	1661	3468108	1650
BIC		1254013	1093	3429566	1534	3468727	1661	3468740	1650
$\chi^2$ Test of Model Fit		2.193	1.468	304.405	13.167	187.655	10.486	201.645	11.746
RMSEA		0.000	0.000	0.017	0.000	0.009	0.000	0.009	0.000
CFI		0.000	0.000	0.970	0.002	0.970	0.002	0.968	0.002
TLI		1.000	0.000	0.927	0.004	0.899	0.007	0.903	0.007
SRMR <i>L1</i>		0.005	0.003	0.016	0.000	0.015	0.000	0.015	0.000
SRMR <i>L2</i>		0.011	0.005			0.014	0.002	0.030	0.006

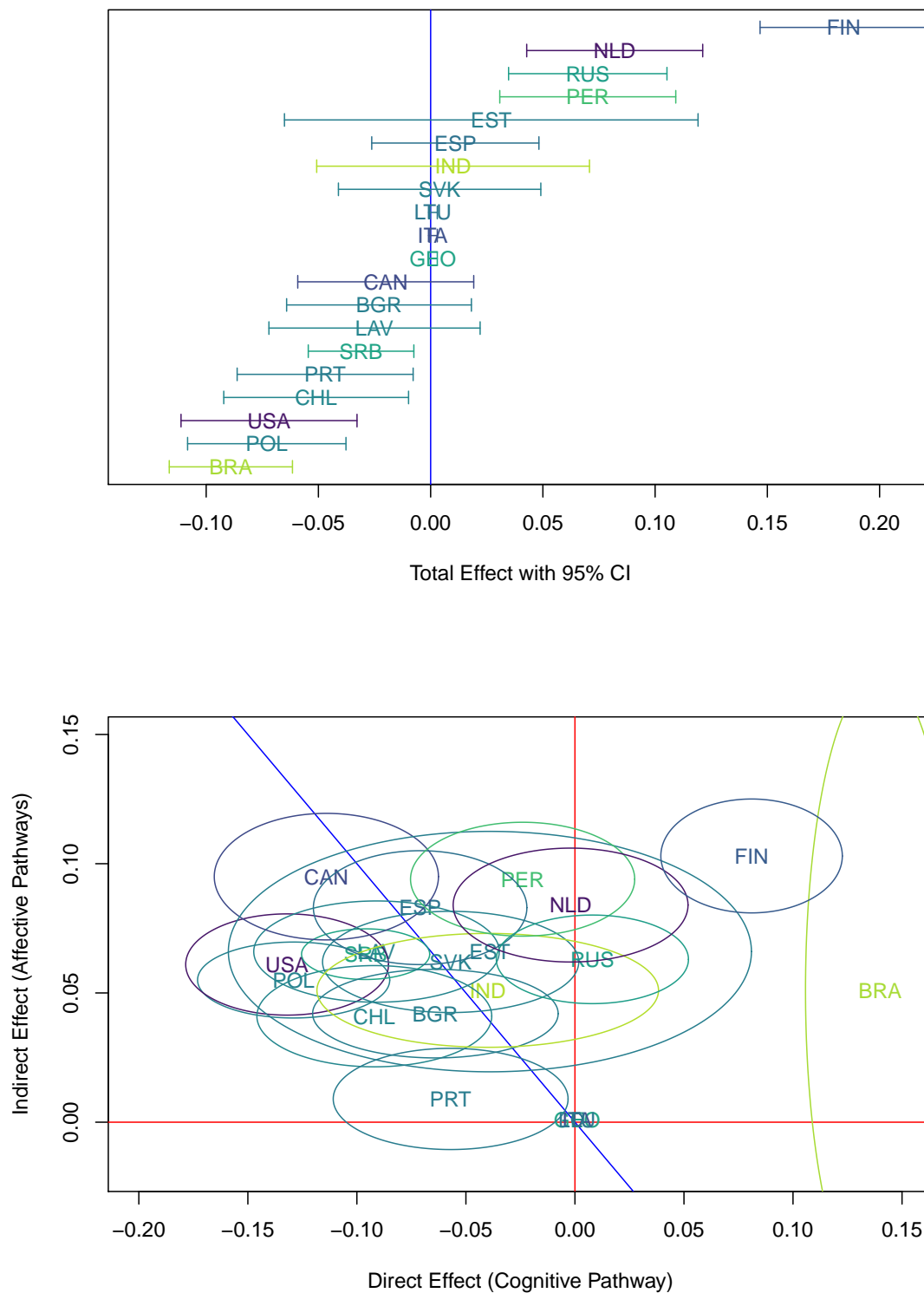
*Note.* All  $p$  values in this table are two-tailed.

† $p < 0.10$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

#### **4.4 Address the research question**

**Figure 4.1**

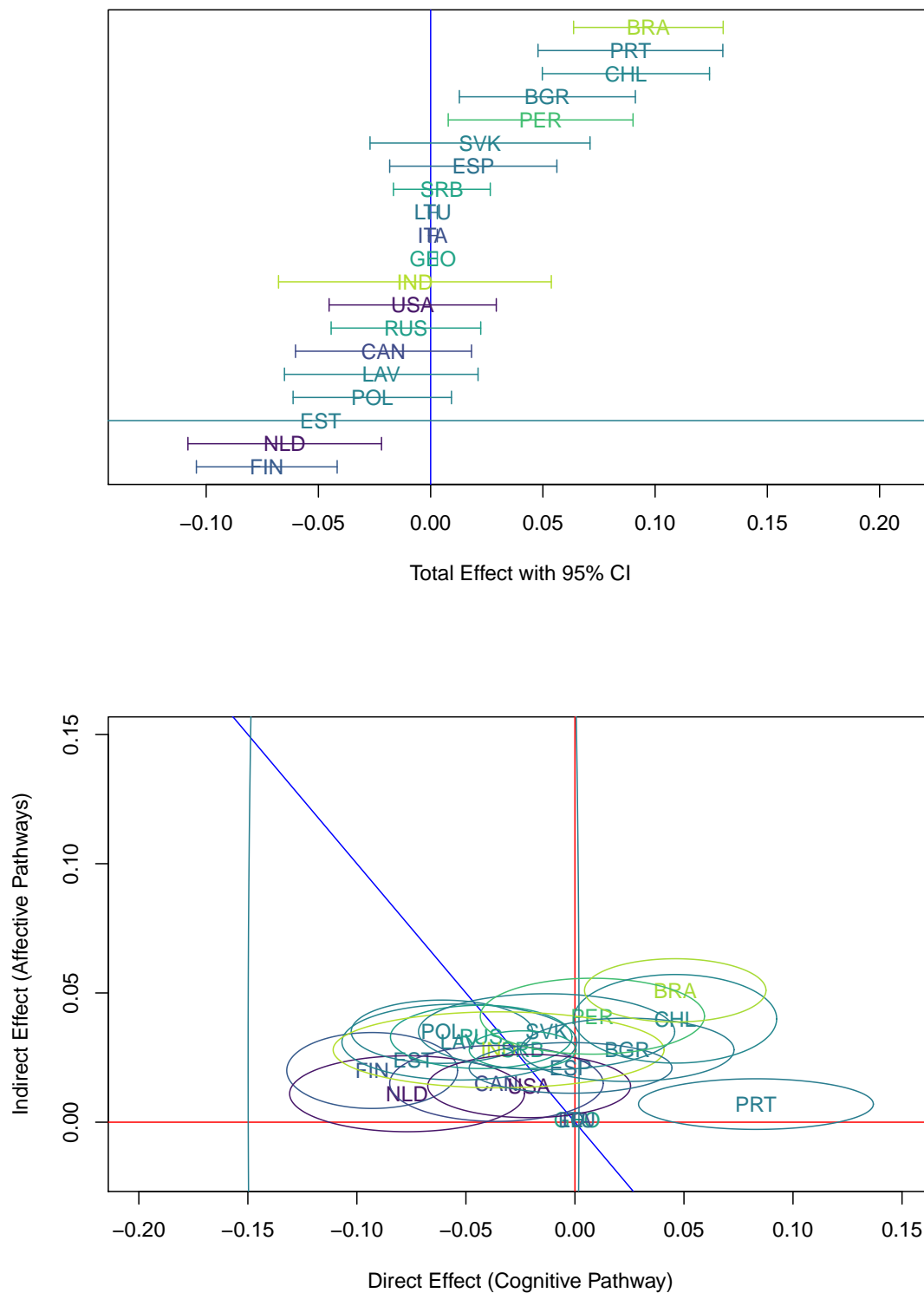
*Total, Direct and Indirect Effects of School Intervention (FLSCHOOL)*



*Note.* Countries with high (low) financial knowledge indices are represented in darker (lighter) colours. Top panel: Estimates with 95% confidence intervals crossing the vertical blue line are not statistically significant. Lower panel: Estimates whose 95% confidence ellipses cross the vertical, horizontal and  $-45^\circ$  lines are not significant for direct, indirect and total effect, respectively.

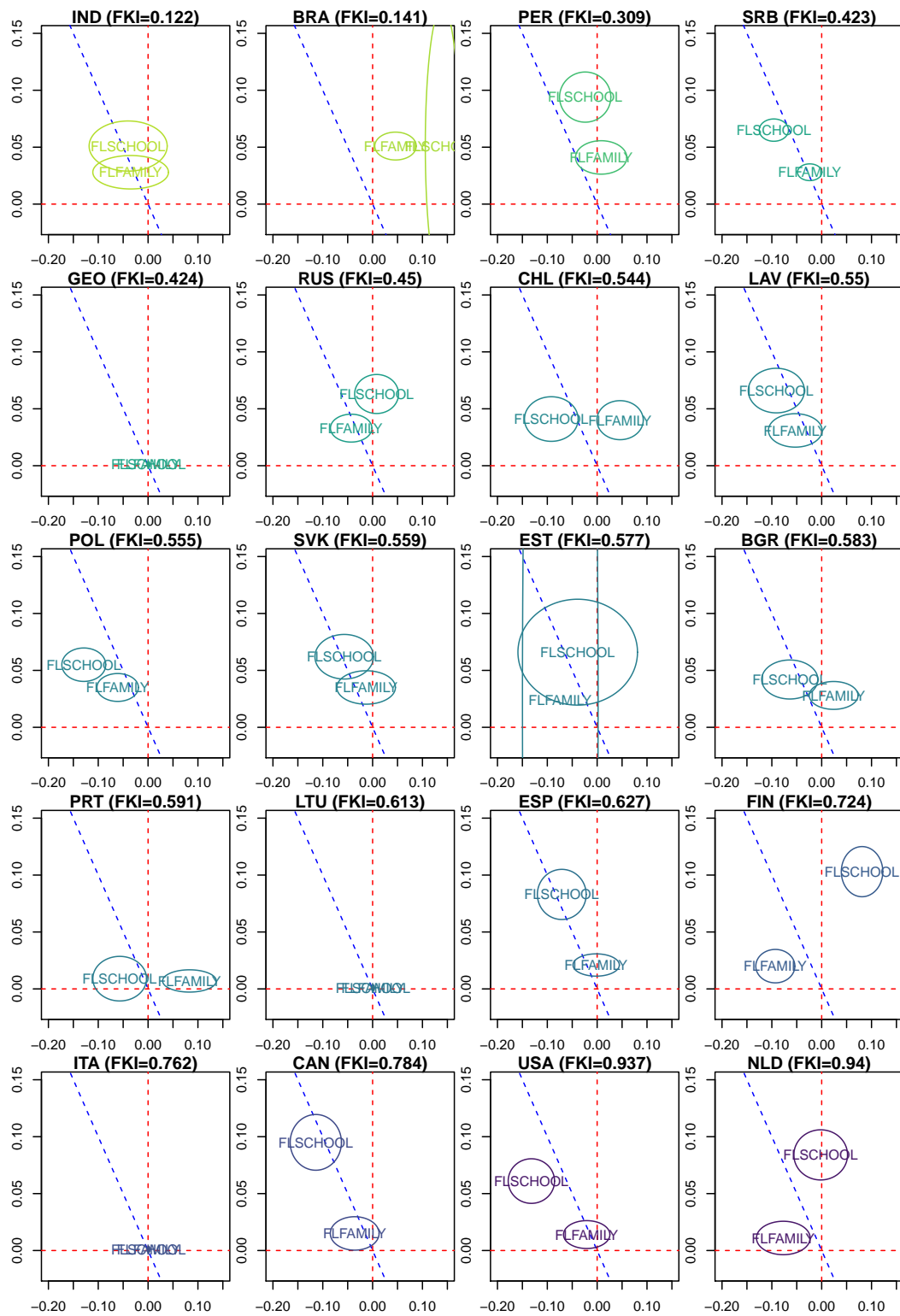
**Figure 4.2**

*Total, Direct and Indirect Effects of Financial Socialisation (FLFAMILY)*



*Note.* Countries with high (low) financial knowledge indices are represented in darker (lighter) colours. Top panel: Estimates with 95% confidence intervals crossing the vertical blue line are not statistically significant. Lower panel: Estimates whose 95% confidence ellipses cross the vertical, horizontal and  $-45^\circ$  lines are not significant for direct, indirect and total effect, respectively.

**Figure 4.3**  
*School-Family Effect Decomposition by Country*



*Note.* Cognitive and affective effects are represented on horizontal and vertical axes respectively.





# Chapter 5 Discussion

## 5.1 Brief summary

5.1.1 Remind readers what my research questions are

## 5.2 The implication of this study

## 5.3 Limitation and future directions

5.3.1 Word in positive form

## 5.4 Bird-eye view

5.4.1 What conclusion I can draw from this paper/study



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# Appendices





# Appendix A Analysis Code, Additional Tables and Figures

## A.1 Chapter 1 Introduction

There is no analysis code in [Chapter 1](#).

## A.2 Chapter 2 Conceptual Framework

## A.3 Chapter 3 Method

**Table A.1***Summary of Participating Countries*

Country	Country	Country	School		Student		Male in each country	
Code	ID	name	count	percentage	count	percentage	count	percentage
76	BRA	Brazil	595	8.97%	8310	7.75%	4045	48.68%
100	BGR	Bulgaria	197	2.97%	4110	3.84%	2147	52.24%
124	CAN	Canada	492	7.42%	7762	7.24%	3858	49.70%
152	CHL	Chile	251	3.79%	4482	4.18%	2254	50.29%
233	EST	Estonia	229	3.45%	4166	3.89%	2080	49.93%
246	FIN	Finland	204	3.08%	4328	4.04%	2199	50.81%
268	GEO	Georgia	319	4.81%	4320	4.03%	2239	51.83%
360	IND	Indonesia	395	5.96%	7132	6.66%	3454	48.43%
380	ITA	Italy	539	8.13%	9182	8.57%	4706	51.25%
428	LVA	Latvia	307	4.63%	3151	2.94%	1587	50.36%
440	LTU	Lithuania	349	5.26%	4075	3.80%	2060	50.55%
528	NLD	the Netherlands	151	2.28%	3042	2.84%	1549	50.92%
604	PER	Peru	337	5.08%	4732	4.42%	2390	50.51%
616	POL	Poland	235	3.54%	4294	4.01%	2080	48.44%
620	PRT	Portugal	276	4.16%	4568	4.26%	2320	50.79%
643	RUS	Russian Federation	558	8.42%	9124	8.51%	4601	50.43%
688	SRB	Serbia	186	2.81%	3874	3.62%	1951	50.36%
703	SVK	Slovak Republic	357	5.38%	3411	3.18%	1683	49.34%
724	ESP	Spain	491	7.40%	9361	8.74%	4695	50.15%
840	USA	the USA	163	2.46%	3738	3.49%	1871	50.05%
Total			6631	100%	107162	100%	53769	50.18%

*Note.* Notes go here.

# Appendix B Multilevel Multiple Imputation

## B.1 Mplus Input Code

```

1 TITLE:
    Multilevel multiple imputation using JM-AM H1 ! Unrestricted var-cov

5 DATA:
    file = "~/finlit.dat";

VARIABLE:
10     names =
        FKI CNTRYID CNTSCHID CNTSTUID W_STU ! Administrative vars
        PV1MATH PV2MATH PV3MATH PV4MATH PV5MATH ! Plausible values for MATH
        PV6MATH PV7MATH PV8MATH PV9MATH PV10MATH
        PV1READ PV2READ PV3READ PV4READ PV5READ ! Plausible values for READ
        PV6READ PV7READ PV8READ PV9READ PV10READ
        PV1FLIT PV2FLIT PV3FLIT PV4FLIT PV5FLIT ! Plausible values for FLIT
        PV6FLIT PV7FLIT PV8FLIT PV9FLIT PV10FLIT
        MALE IMMI1GEN IMMI2GEN ESCS ! Demographic info
        FCFMLRTY FLCONFIN ! Affects
        FLSCHOOL ! Lat var "Academic"
        NOBULLY ! Lat var "Safety"
        FLFAMILY ! Lat var "Community"
        W_SCH STRATIO ! School characteristics
        EDUSHORT ! Lat var "inst. env."
25     ;

    usevar = ! Var to be imputed
        MALE IMMI1GEN IMMI2GEN ESCS
        FCFMLRTY FLCONFIN
        FLSCHOOL NOBULLY FLFAMILY
30     STRATIO EDUSHORT
        ;

    within = ! Amongst which, L1 var are
        MALE IMMI1GEN IMMI2GEN ESCS
        FCFMLRTY FLCONFIN
        FLSCHOOL NOBULLY FLFAMILY
35     ;

    between = ! L2 are
        STRATIO EDUSHORT
40     ;

    auxiliary = ! Var not participating in
        PV1MATH PV2MATH PV3MATH PV4MATH PV5MATH ! MI but still to be
        PV6MATH PV7MATH PV8MATH PV9MATH PV10MATH ! included in final output
        PV1READ PV2READ PV3READ PV4READ PV5READ
        PV6READ PV7READ PV8READ PV9READ PV10READ ! PVs are already "guesses"
        PV1FLIT PV2FLIT PV3FLIT PV4FLIT PV5FLIT ! themselves so do NOT use
        PV6FLIT PV7FLIT PV8FLIT PV9FLIT PV10FLIT ! PVs to guess others
50     FKI CNTRYID CNTSTUID W_STU
        W_SCH ! Admin vars
        ;

55     cluster = CNTSCHID;

    missing = all (-99);

60 ANALYSIS:
    processors = 64; ! Use all cores of HPC

    type = twolevel;
    estimator = Bayes;

```

```

65      fbiterations = 50000;           ! Number of burn-in
      chains = 4;                     ! Verify convergence
      bseed = 1234;                   ! For replication study

70  DATA IMPUTATION:
      impute =
          MALE (c) IMMI1GEN (c) IMMI2GEN (c) ESCS      ! Categoricals have (c)
          FCFMLRTY FLCONFIN
75      FLSCHOOL NOBULLY FLFAMILY
          STRATIO EDUSHORT
          ;

      ndatasets = 10;                 ! To merge with 10 PVs
80      save = FLIT_MMI_*.dat;
      thin = 5000;                     ! To Avoid autocorrelation

SAVEDATA:
      bpar = bpar.dat;                 ! Capture Bayesian paths

85  PLOT:
      type = plot2;                     ! For R's MplusAutomation

```

## B.2 Selected Mplus Output

```

1  MODEL FIT INFORMATION
      Number of Free Parameters                22

5  Bayesian Posterior Predictive Checking using Chi-Square

      95% Confidence Interval for the Difference Between
      the Observed and the Replicated Chi-Square Values

10      28408.938      28906.315

      Posterior Predictive P-Value            0.000

Information Criteria
15      Deviance (DIC)                2100842.641
      Estimated Number of Parameters (pD)    22.054

20  MODEL RESULTS

      Estimate      Posterior      One-Tailed      95% C.I.
      S.D.      P-Value      Lower 2.5%      Upper 2.5%      Significance

25  Within Level

Means
30      MALE      0.502      0.002      0.000      0.499      0.505      *
      IMMI1GEN      0.029      0.001      0.000      0.028      0.030      *
      IMMI2GEN      0.042      0.001      0.000      0.041      0.044      *
      ESCS      -0.241      0.003      0.000      -0.247      -0.234      *
      FCFMLRTY      7.049      0.017      0.000      7.015      7.083      *
      FLCONFIN      -0.072      0.003      0.000      -0.079      -0.065      *
35      FLSCHOOL      0.018      0.003      0.000      0.011      0.024      *
      NOBULLY      -0.059      0.004      0.000      -0.067      -0.052      *
      FLFAMILY      0.064      0.003      0.000      0.057      0.070      *

Variances
40      MALE      0.250      0.001      0.000      0.248      0.252      *
      IMMI1GEN      0.028      0.000      0.000      0.028      0.028      *
      IMMI2GEN      0.041      0.000      0.000      0.040      0.041      *
      ESCS      1.183      0.005      0.000      1.173      1.193      *
      FCFMLRTY      29.753      0.134      0.000      29.494      30.016      *
45      FLCONFIN      1.034      0.005      0.000      1.025      1.044      *

```

	FLSCHOOL	1.040	0.005	0.000	1.031	1.049	*
	NOBULLY	1.110	0.005	0.000	1.100	1.121	*
	FLFAMILY	1.090	0.005	0.000	1.080	1.100	*
50	Between Level						
	Means						
	STRATIO	13.873	0.136	0.000	13.608	14.140	*
55	EDUSHORT	0.131	0.013	0.000	0.106	0.157	*
	Variances						
	STRATIO	103.514	1.948	0.000	99.805	107.425	*
	EDUSHORT	1.074	0.019	0.000	1.038	1.112	*

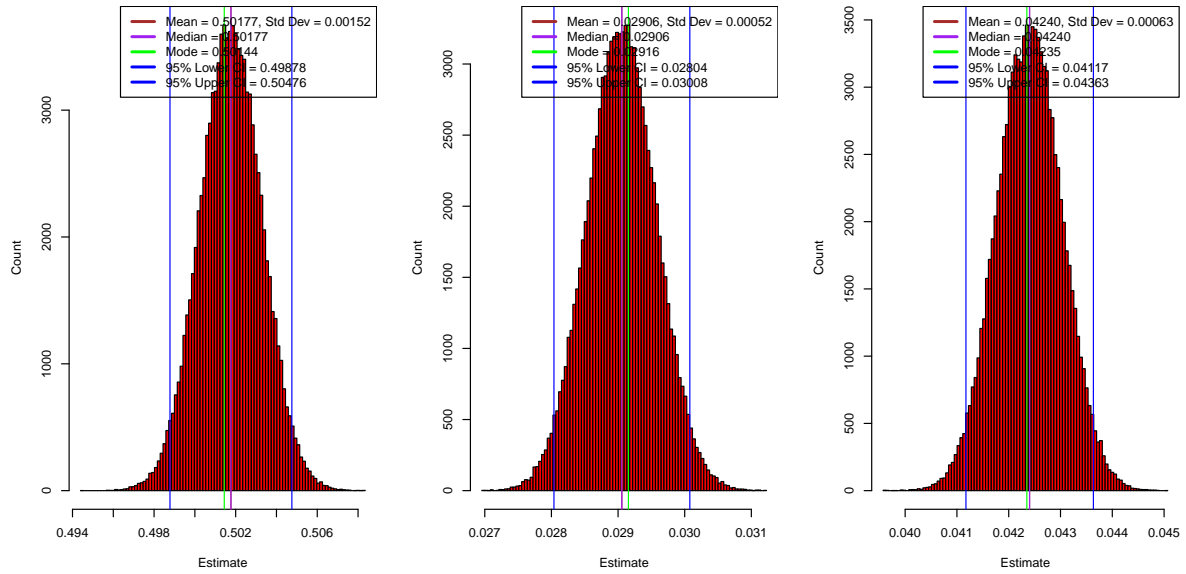
### B.3 Diagnostic Plots

**Table B.1***Summary of Diagnostic Plots of Multilevel Multiple Imputation*

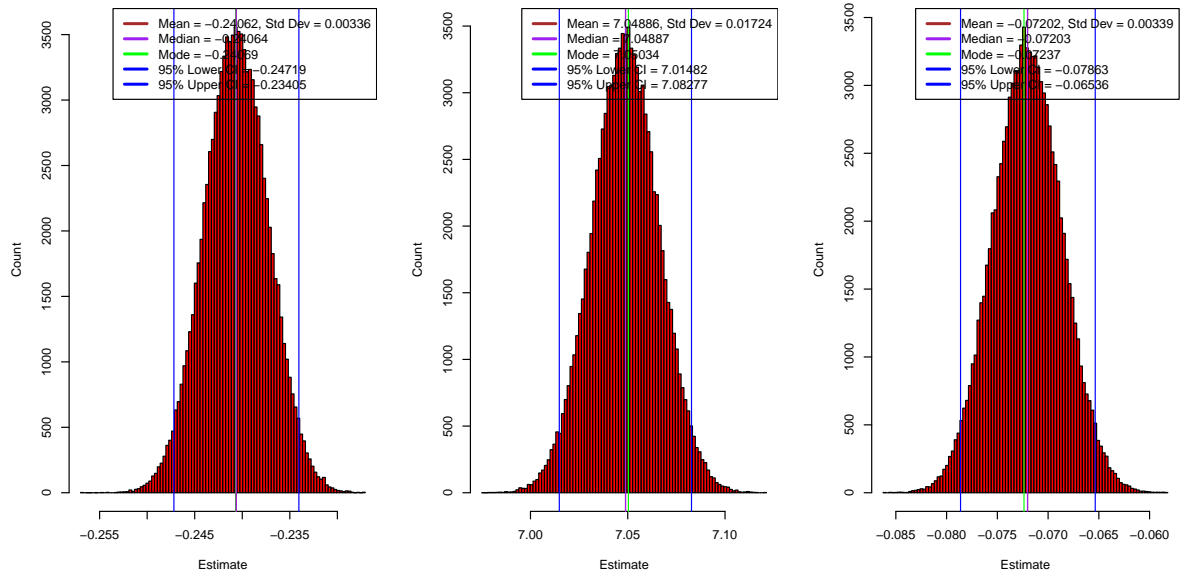
Parameter number	Parameter label	Modelling level	Brief description	Posterior mean	Posterior variance	95% CI of distribution	Chain converged	AR-free chains
1	MALE	Within	Whether participant is male	0.502		(0.499, 0.505)	Yes	4
2	IMMI1GEN	Within	Whether participant migrated to this country	0.029		(0.028, 0.030)	Yes	4
3	IMMI2GEN	Within	Whether their parent did	0.042		(0.041, 0.044)	Yes	4
4	ESCS	Within	Index of economic, social and cultural status	−0.241		(−0.247, −0.234)	Yes	4
5	FCFMLRTY	Within	Familiarity with concepts of finance	7.049		(7.015, 7.083)	Yes	4
6	FLCONFIN	Within	Confidence about financial matters	−0.072		(−0.079, −0.065)	Yes	4
7	FLSCHOOL	Within	Financial education in school lessons	0.018		(0.011, 0.024)	Yes	4
8	NOBULLY	Within	Participant's experience of being bullied (reverse)	−0.059		(−0.067, −0.052)	Yes	4
9	FLFAMILY	Within	Parental involvement in matters of financial literacy	0.064		(0.057, 0.070)	Yes	4
10	MALE	Within	Whether participant is male		0.250	(0.248, 0.252)	Yes	4
11	IMMI1GEN	Within	Whether participant migrated to this country		0.028	(0.028, 0.028)	Yes	4
12	IMMI2GEN	Within	Whether their parent		0.041	(0.040, 0.041)	Yes	4
13	ESCS	Within	Index of economic, social and cultural status		1.183	(1.173, 1.193)	Yes	4
14	FCFMLRTY	Within	Familiarity with concepts of finance		29.754	(29.495, 30.016)	Yes	4
15	FLCONFIN	Within	Confidence about financial matters		1.034	(1.025, 1.044)	Yes	4
16	FLSCHOOL	Within	Financial education in school lessons		1.040	(1.031, 1.049)	Yes	4
17	NOBULLY	Within	Participant's experience of being bullied (reverse)		1.111	(1.100, 1.121)	Yes	4
18	FLFAMILY	Within	Parental involvement in matters of financial literacy		1.090	(1.080, 1.100)	Yes	4
19	STRAIO	Between	Student–teacher ratio	13.873		(13.607, 14.139)	Yes	4
20	EDUSHORT	Between	Shortage of educational material	0.131		(0.106, 0.157)	Yes	4
21	STRAIO	Between	Student–teacher ratio		103.532	(99.750, 107.430)	Yes	4
22	EDUSHORT	Between	Shortage of educational material		1.074	(1.037, 1.112)	Yes	4

*Note.* Notes go here.

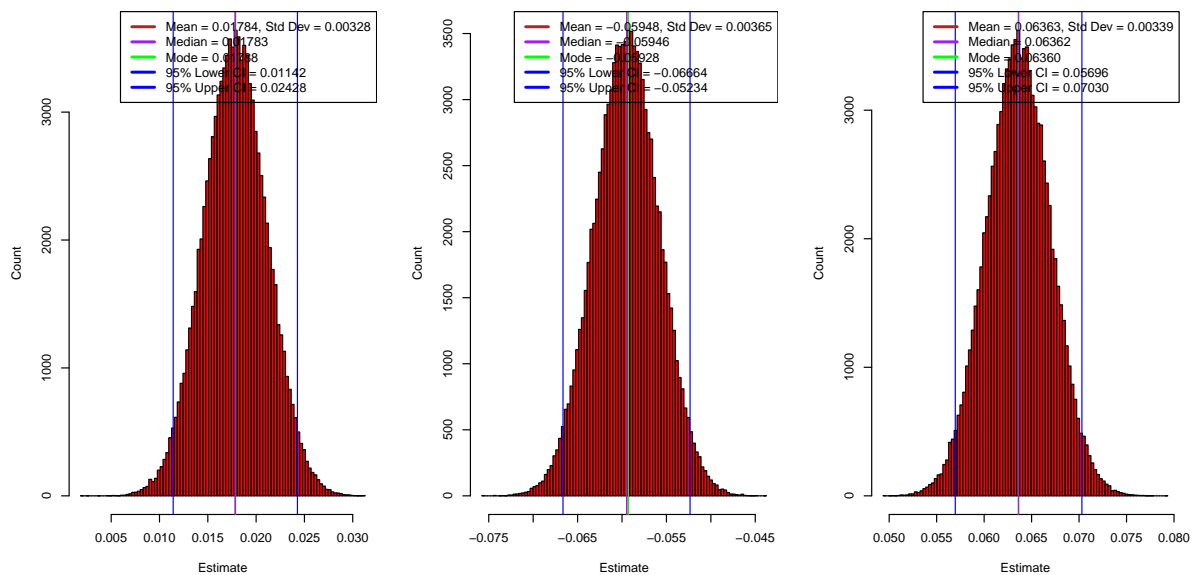
Distribution of: Parameter 1, %WITHIN%: [ MALE ] Distribution of: Parameter 2, %WITHIN%: [ IMMI1GEI Distribution of: Parameter 3, %WITHIN%: [ IMMI2GEI



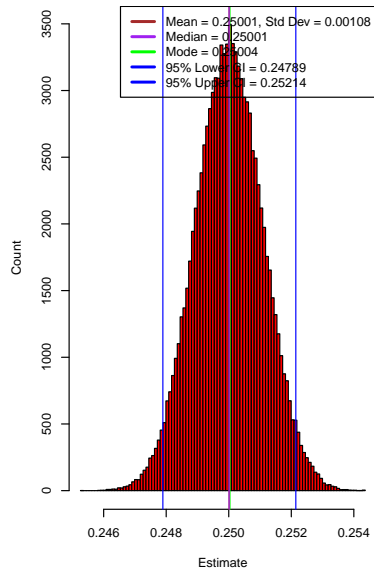
Distribution of: Parameter 4, %WITHIN%: [ ESCS ] Distribution of: Parameter 5, %WITHIN%: [ FCFMLRT Distribution of: Parameter 6, %WITHIN%: [ FLCONFI



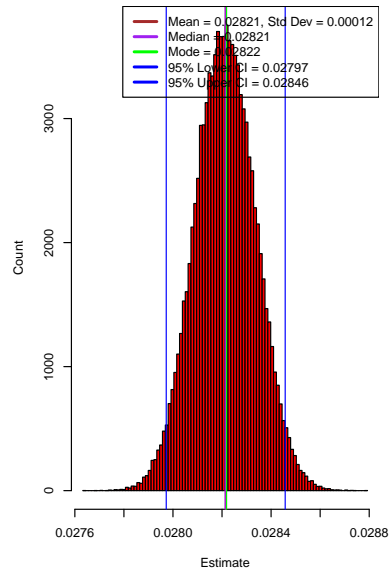
Distribution of: Parameter 7, %WITHIN%: [ FLSCHOC Distribution of: Parameter 8, %WITHIN%: [ NOBULL' Distribution of: Parameter 9, %WITHIN%: [ FLFAMIL'



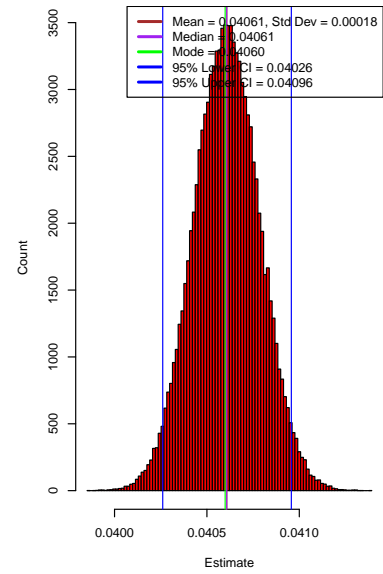
Distribution of: Parameter 10, %WITHIN%: MALE



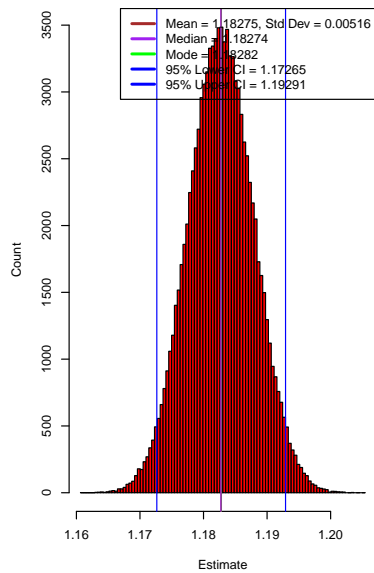
Distribution of: Parameter 11, %WITHIN%: IMMI1GE



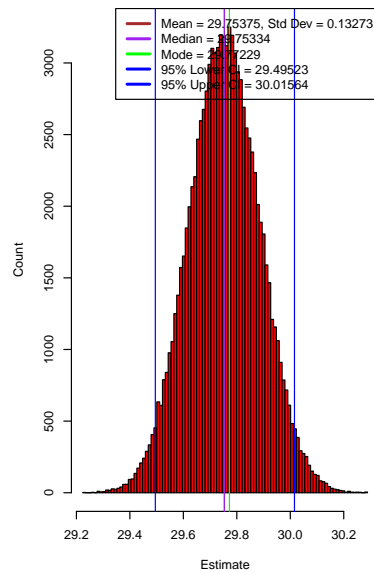
Distribution of: Parameter 12, %WITHIN%: IMMI2GE



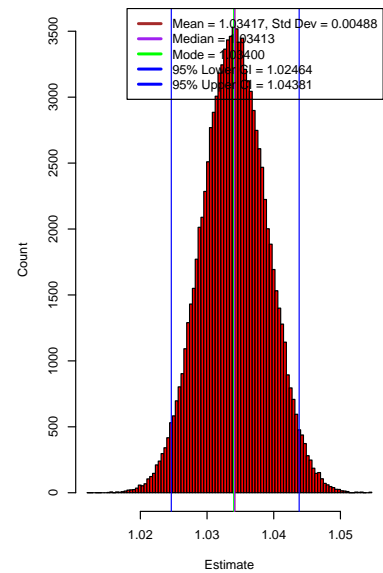
Distribution of: Parameter 13, %WITHIN%: ESCS



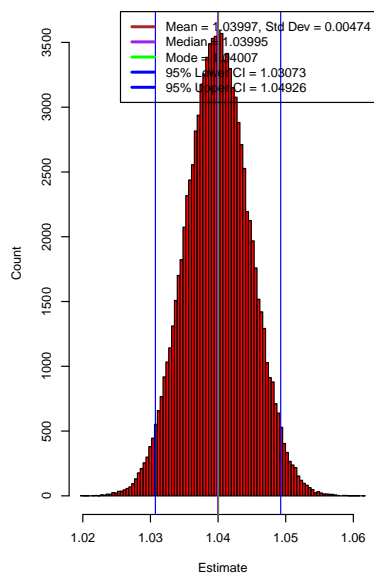
Distribution of: Parameter 14, %WITHIN%: FCFMLR'



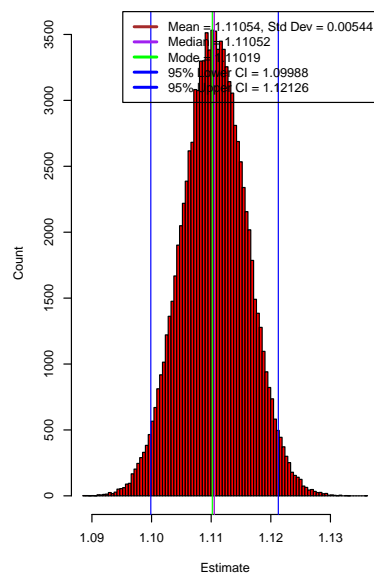
Distribution of: Parameter 15, %WITHIN%: FLCONF



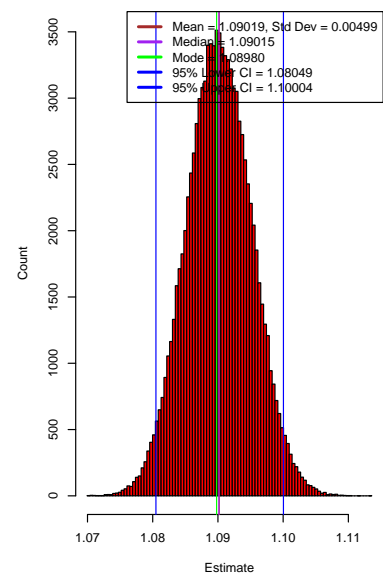
Distribution of: Parameter 16, %WITHIN%: FLSCHO



Distribution of: Parameter 17, %WITHIN%: NOBULL

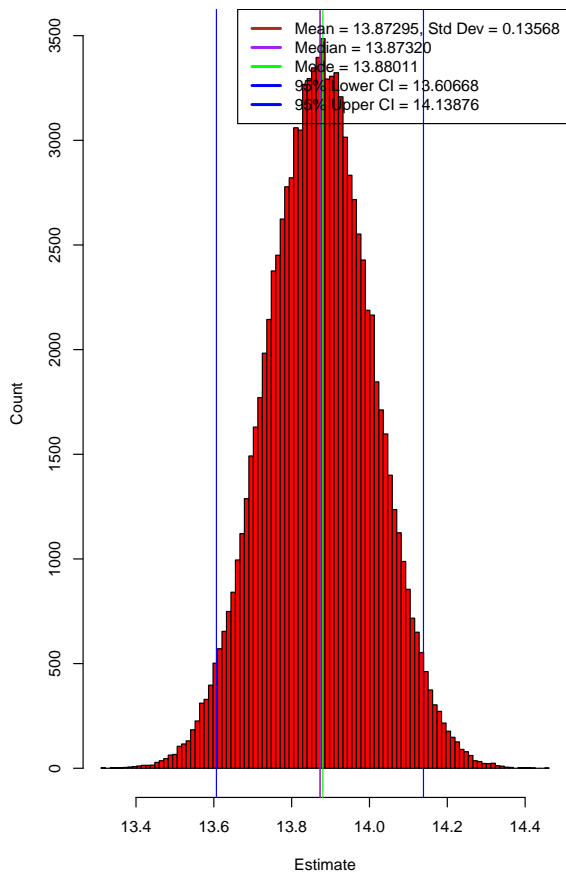


Distribution of: Parameter 18, %WITHIN%: FLFAMIL

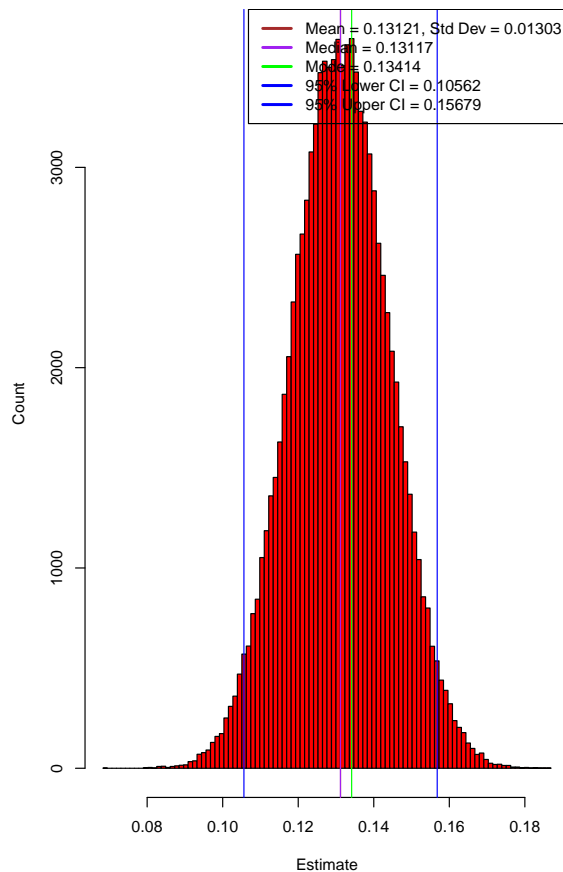




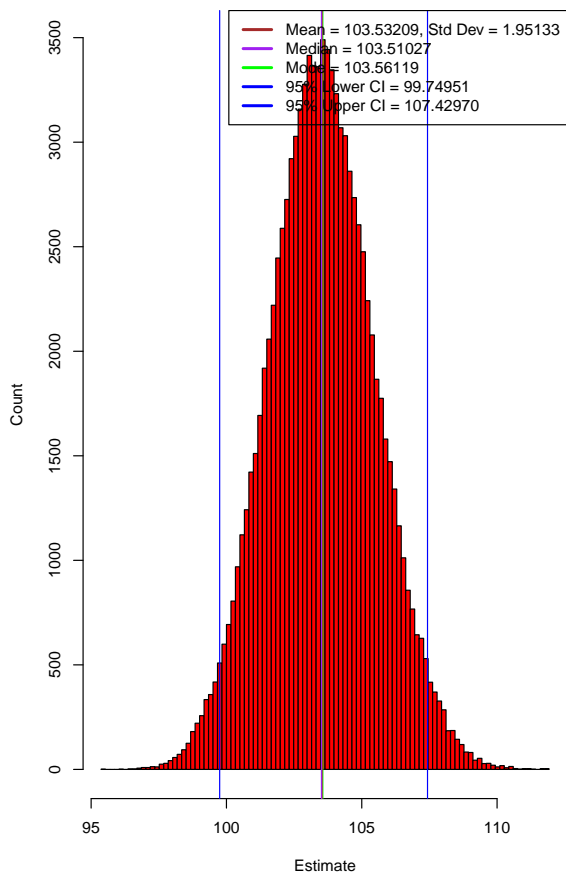
Distribution of: Parameter 19, %BETWEEN%: [ STRATIO ]



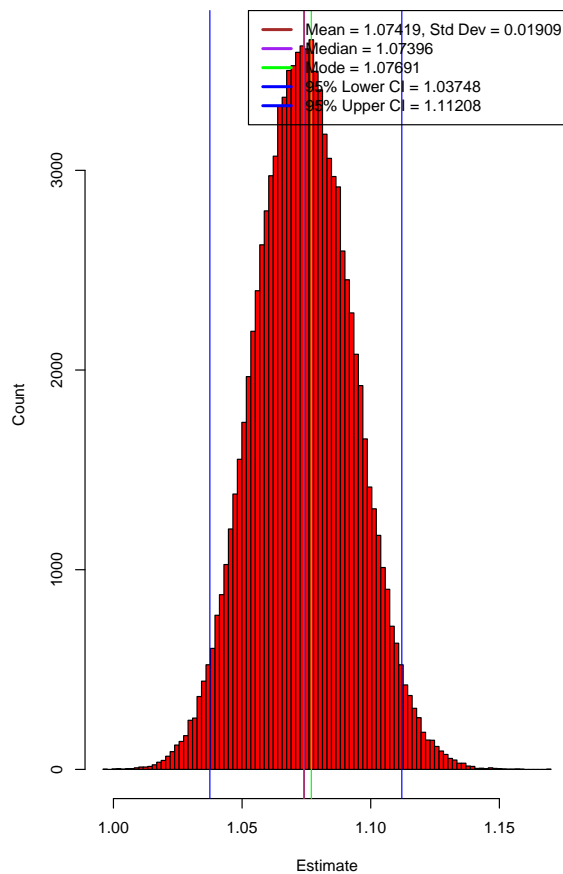
Distribution of: Parameter 20, %BETWEEN%: [ EDUSHORT ]



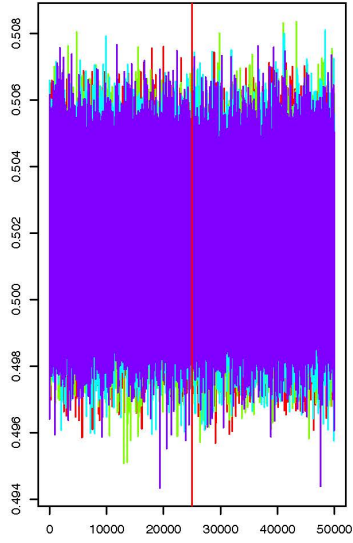
Distribution of: Parameter 21, %BETWEEN%: STRATIO



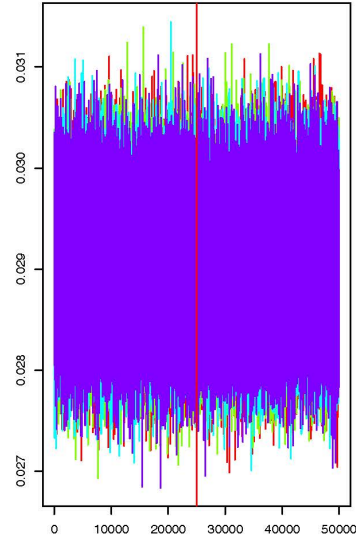
Distribution of: Parameter 22, %BETWEEN%: EDUSHORT



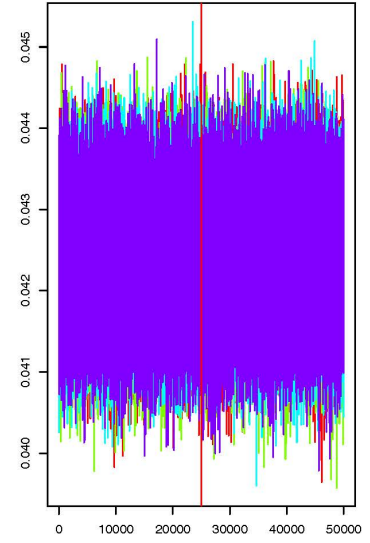
Trace plot of: Parameter 1, %WITHIN%: [ MALE ]



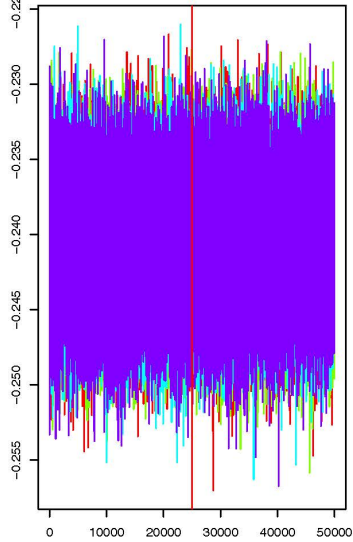
Trace plot of: Parameter 2, %WITHIN%: [ IMMI1GEN



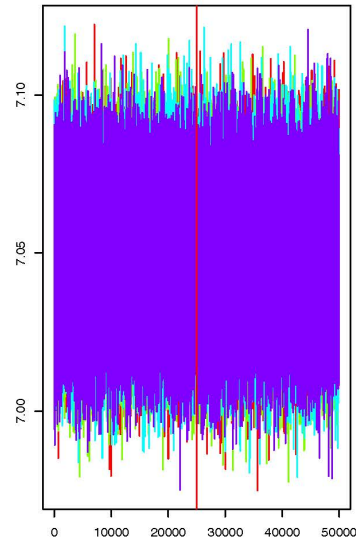
Trace plot of: Parameter 3, %WITHIN%: [ IMMI2GEN



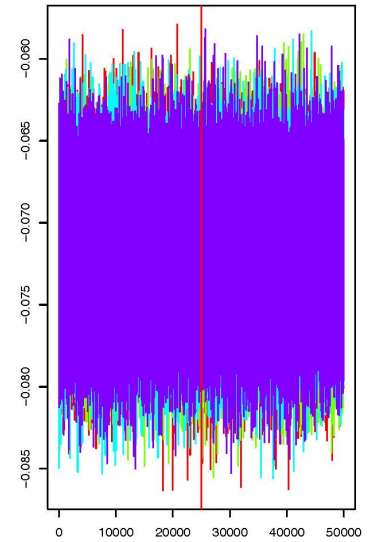
Trace plot of: Parameter 4, %WITHIN%: [ ESCS ]



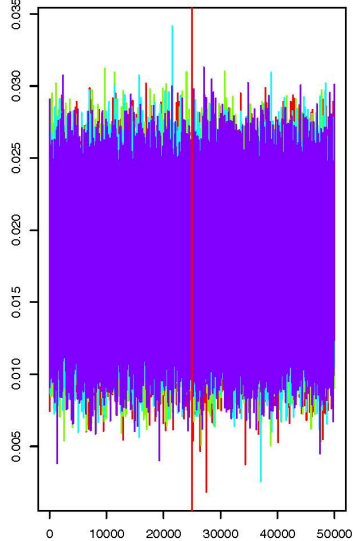
Trace plot of: Parameter 5, %WITHIN%: [ FCFMLRT'



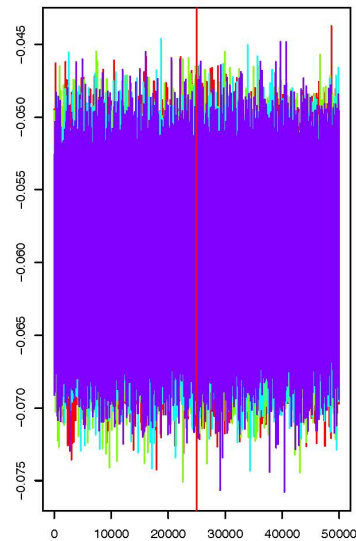
Trace plot of: Parameter 6, %WITHIN%: [ FLCONFIN



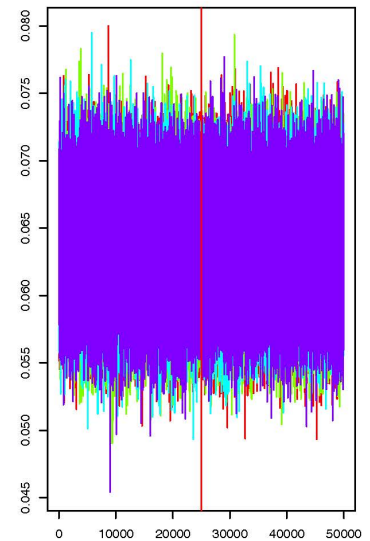
Trace plot of: Parameter 7, %WITHIN%: [ FLSCHOOI



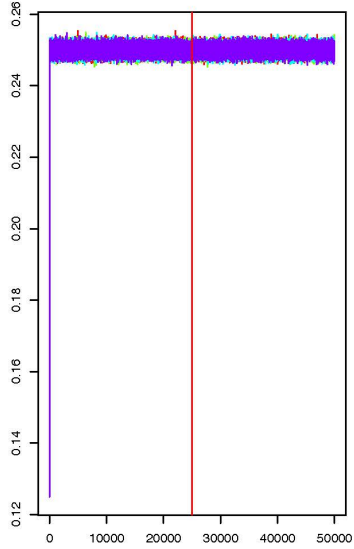
Trace plot of: Parameter 8, %WITHIN%: [ NOBULLY



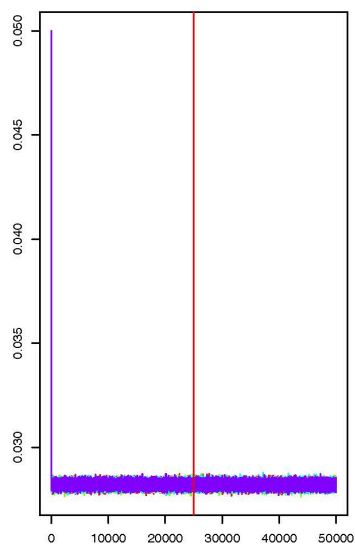
Trace plot of: Parameter 9, %WITHIN%: [ FLFAMILY



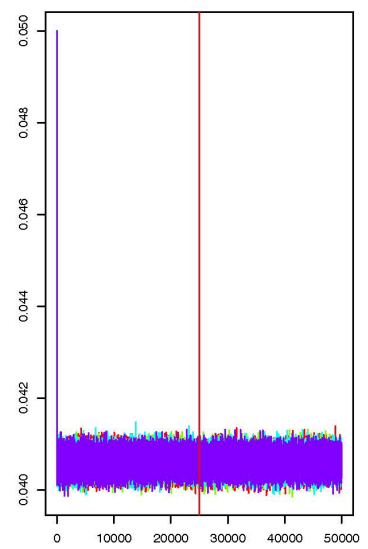
Trace plot of: Parameter 10, %WITHIN%: MALE



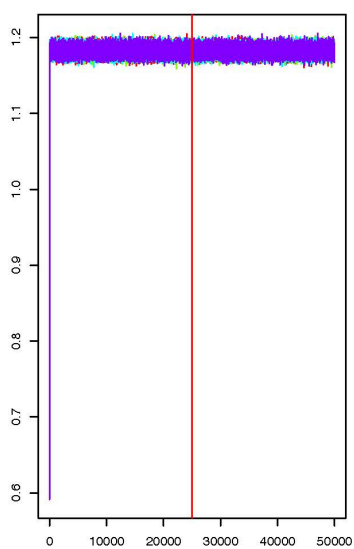
Trace plot of: Parameter 11, %WITHIN%: IMMI1GEI



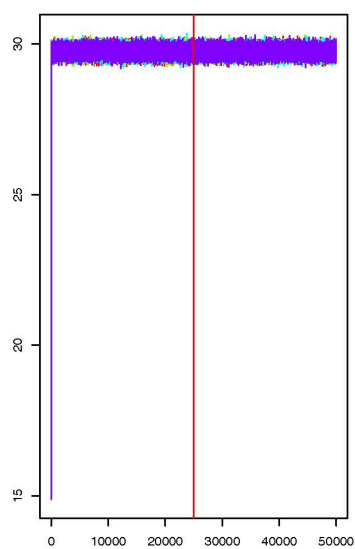
Trace plot of: Parameter 12, %WITHIN%: IMMI2GEI



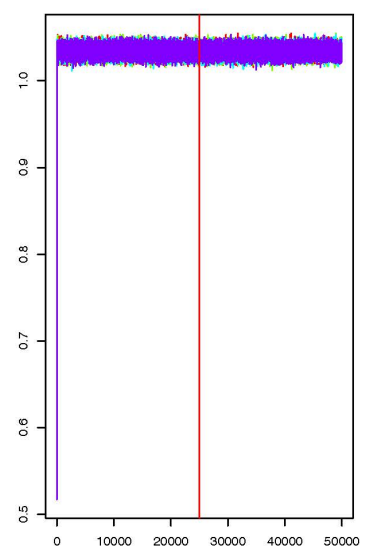
Trace plot of: Parameter 13, %WITHIN%: ESCS



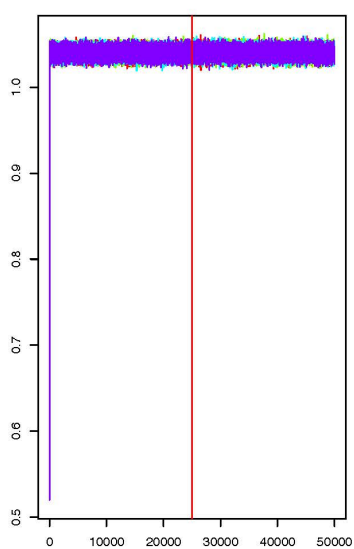
Trace plot of: Parameter 14, %WITHIN%: FCFMLRT



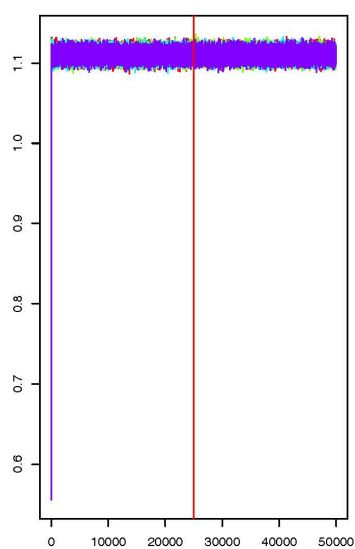
Trace plot of: Parameter 15, %WITHIN%: FLCONFII



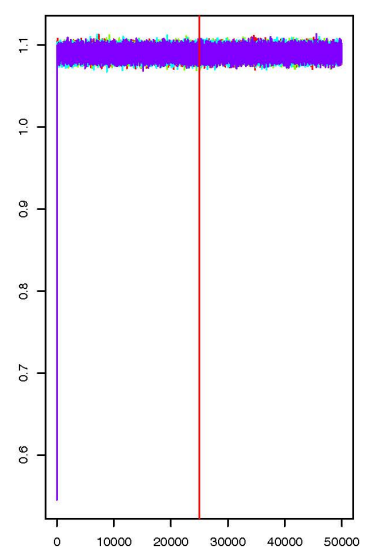
Trace plot of: Parameter 16, %WITHIN%: FLSCHOO



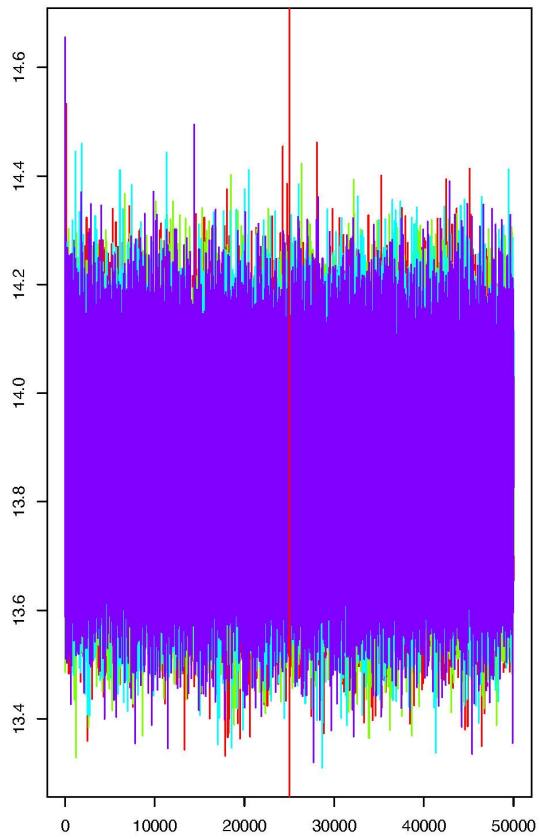
Trace plot of: Parameter 17, %WITHIN%: NOBULL\



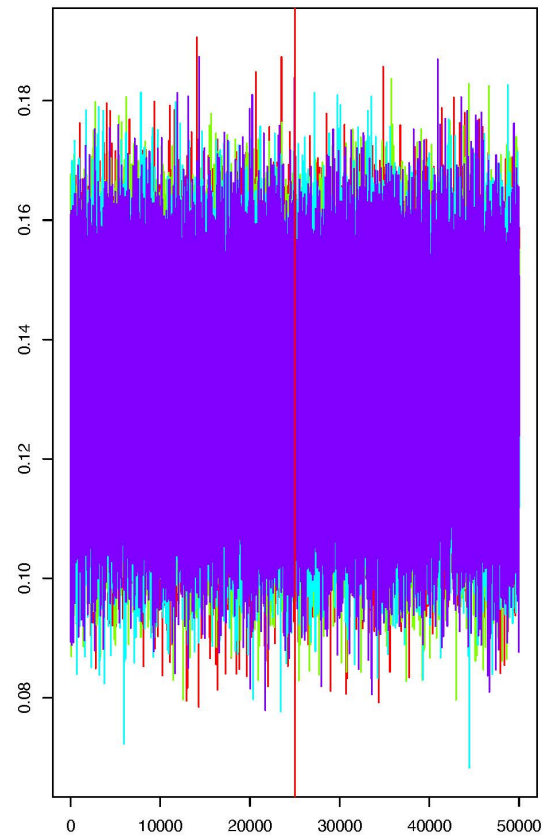
Trace plot of: Parameter 18, %WITHIN%: FLFAMIL\



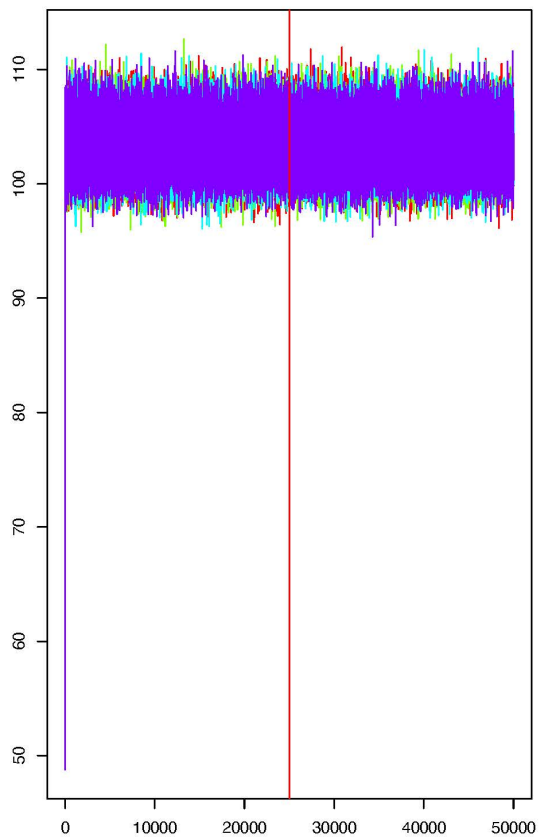
Trace plot of: Parameter 19, %BETWEEN%: [ STRATIO ]



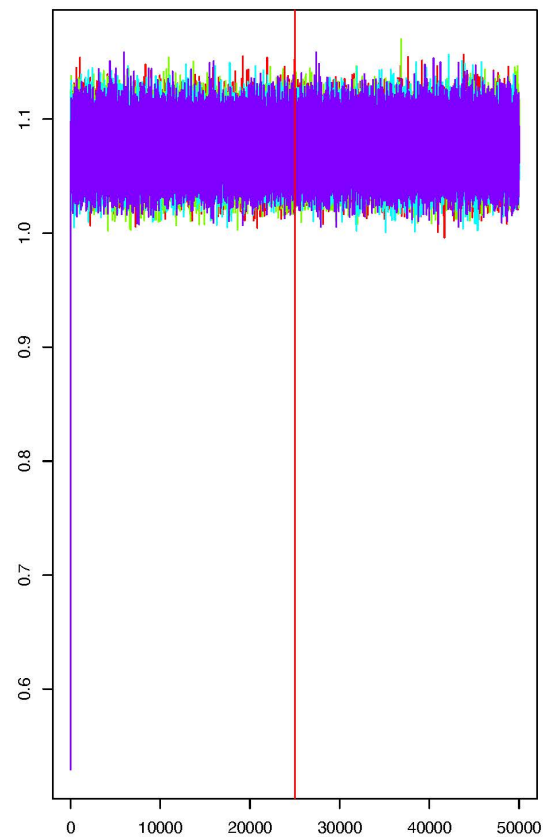
Trace plot of: Parameter 20, %BETWEEN%: [ EDUSHORT ]



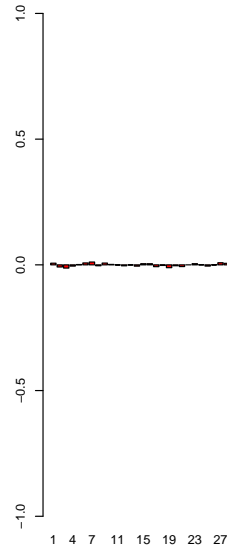
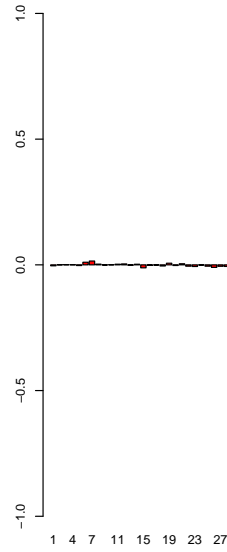
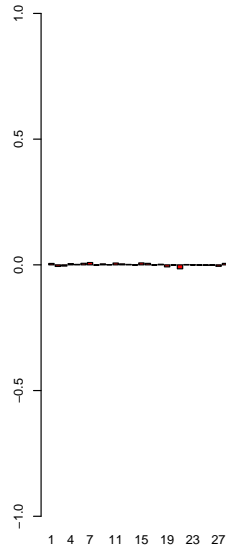
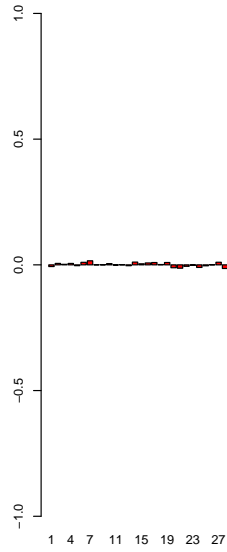
Trace plot of: Parameter 21, %BETWEEN%: STRATIO



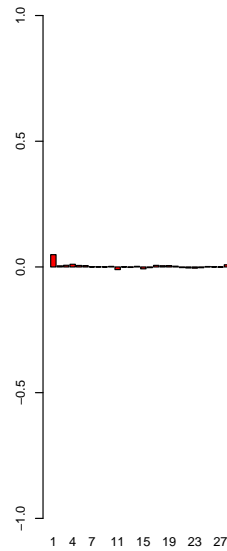
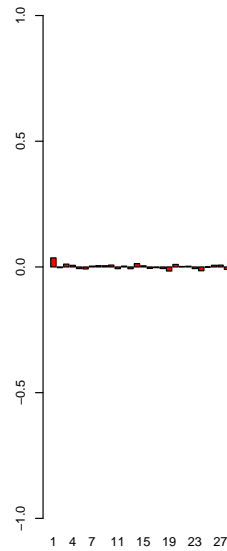
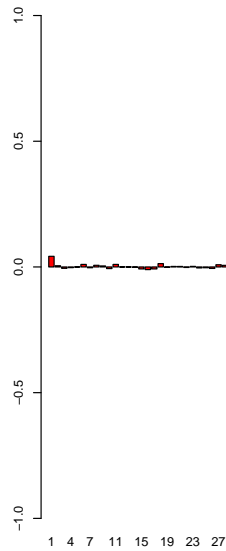
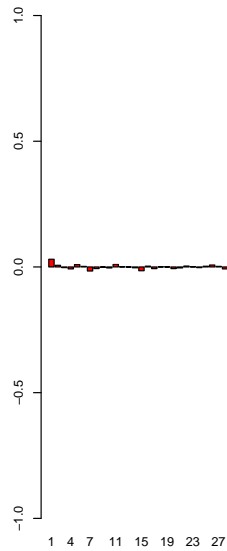
Trace plot of: Parameter 22, %BETWEEN%: EDUSHORT



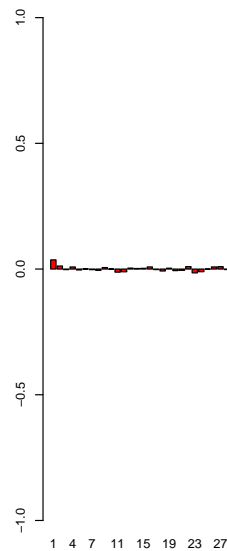
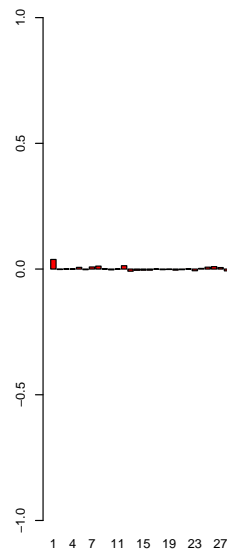
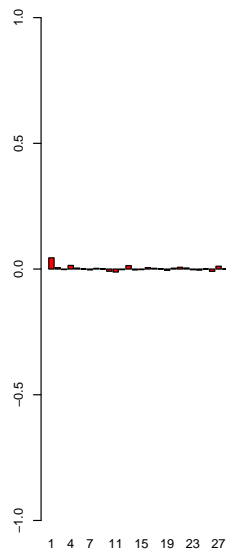
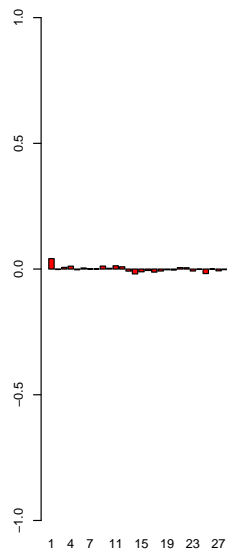
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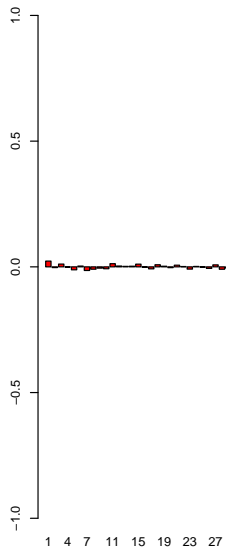
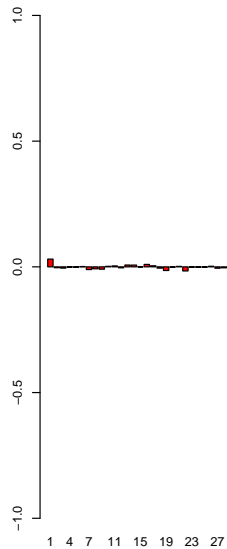
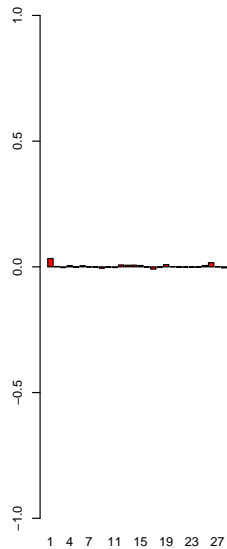
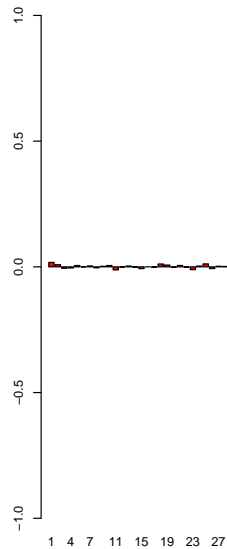
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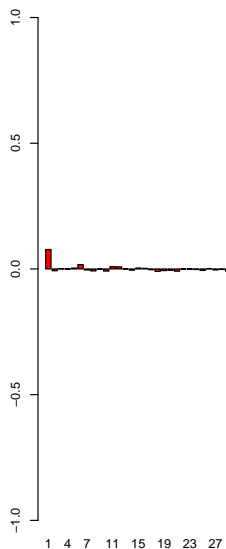
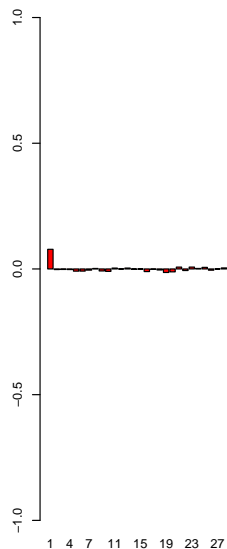
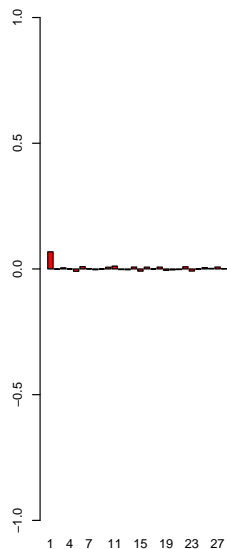
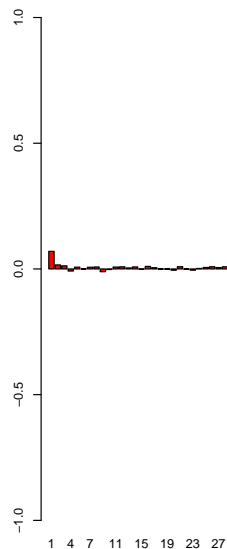
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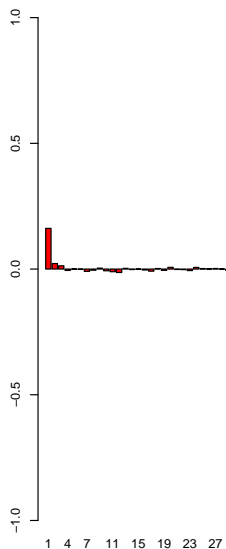
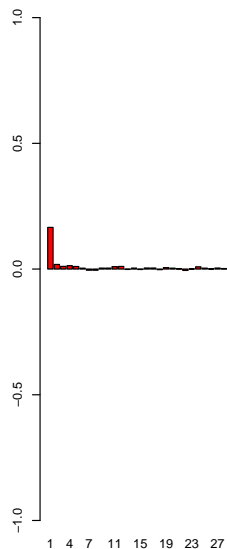
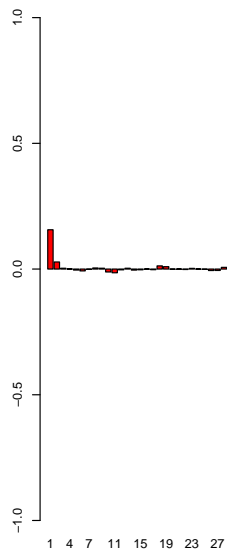
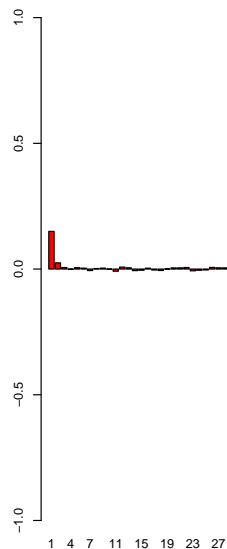
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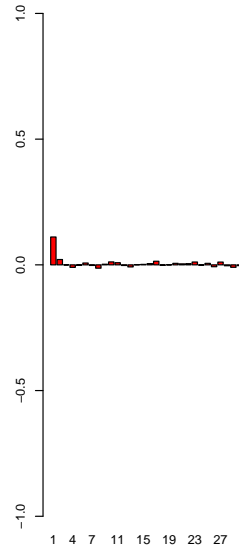
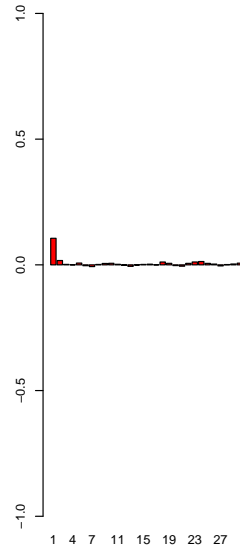
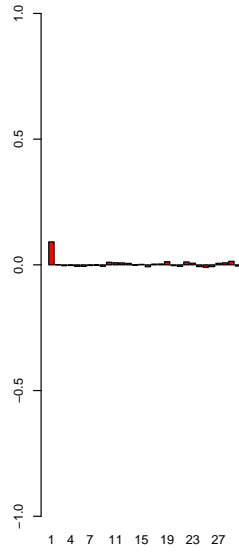
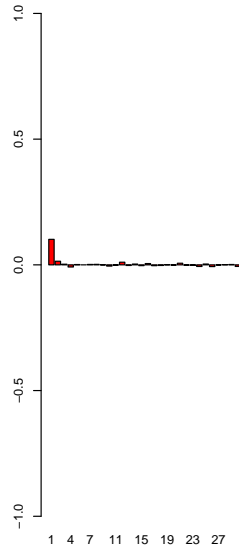
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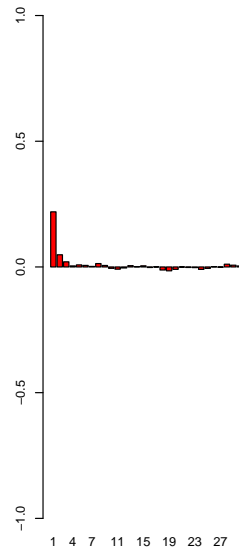
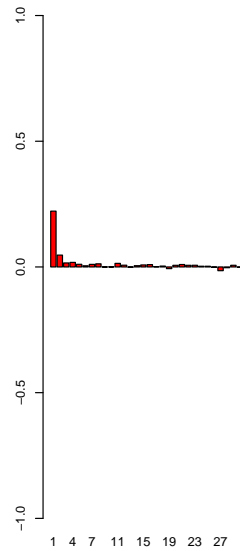
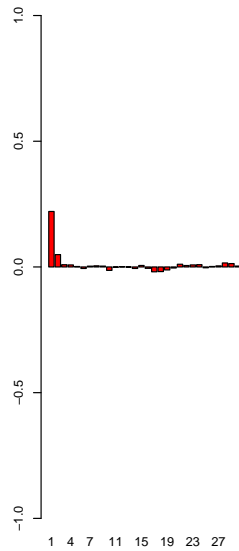
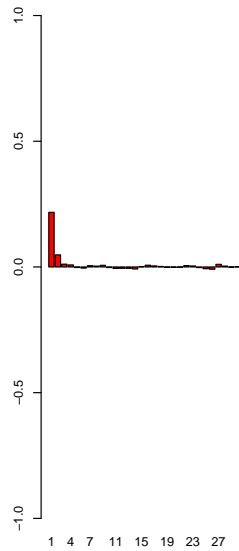
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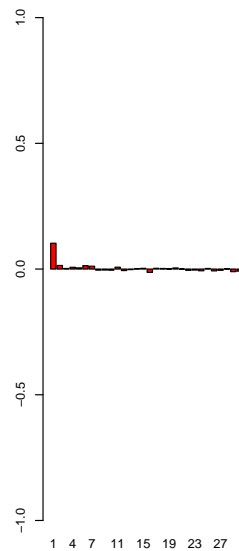
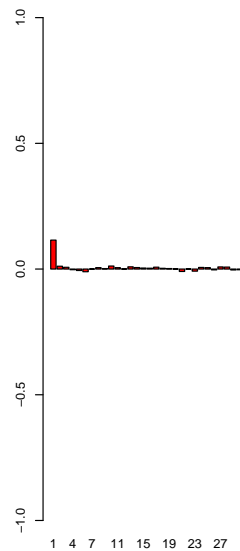
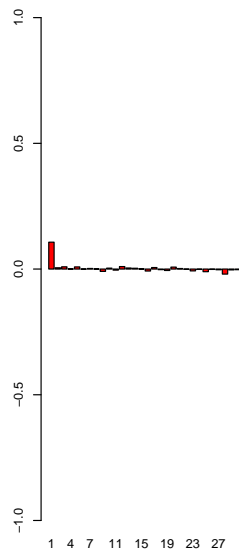
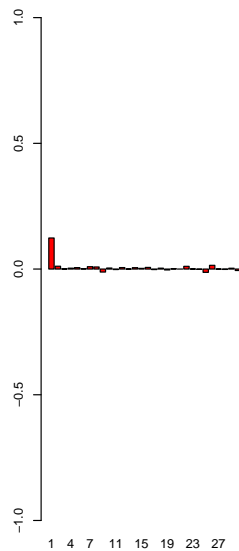
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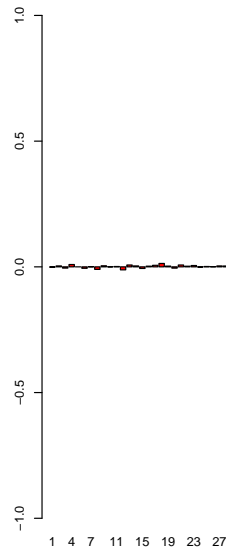
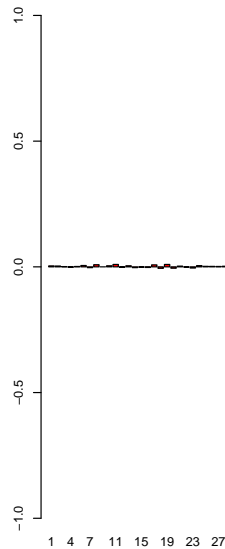
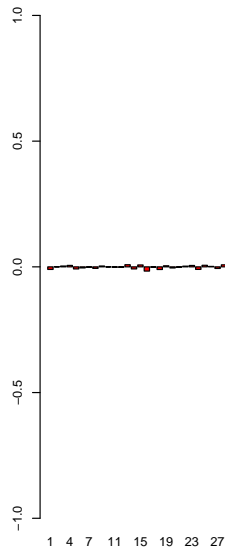
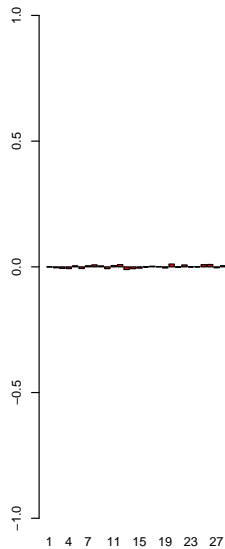
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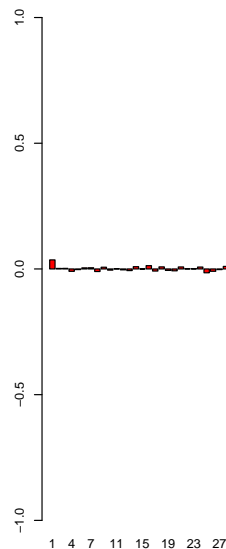
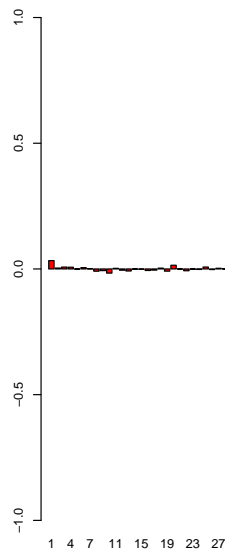
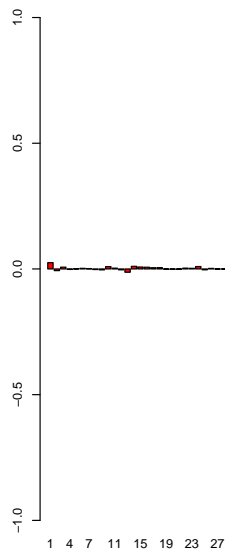
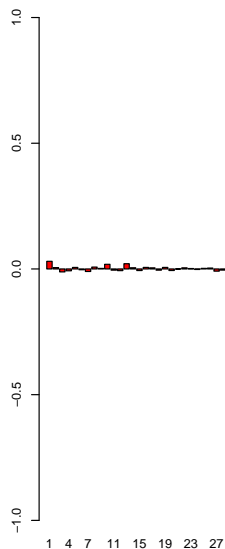
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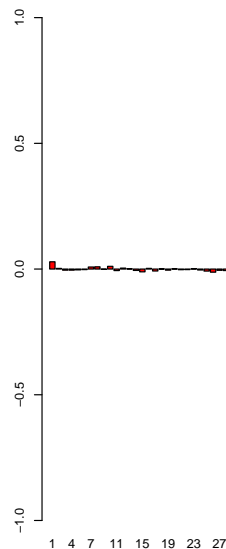
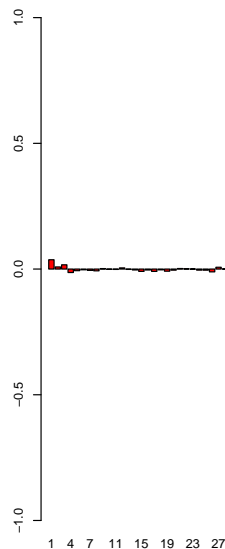
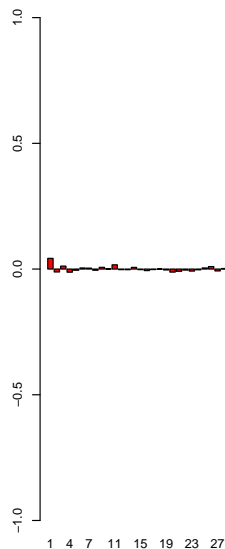
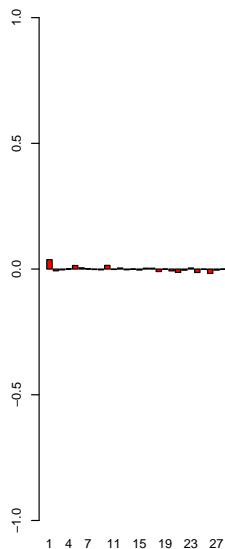
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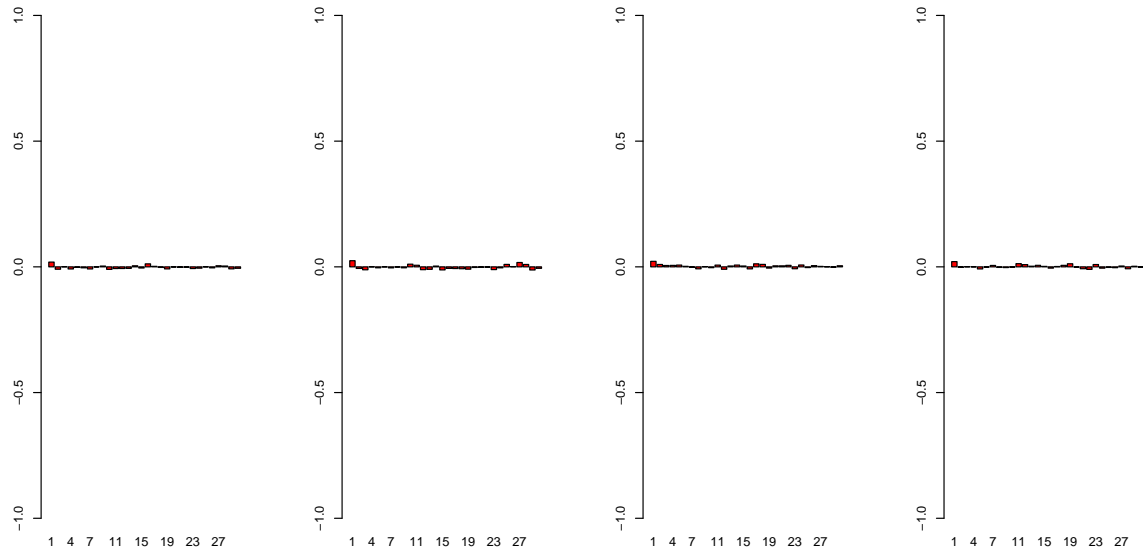


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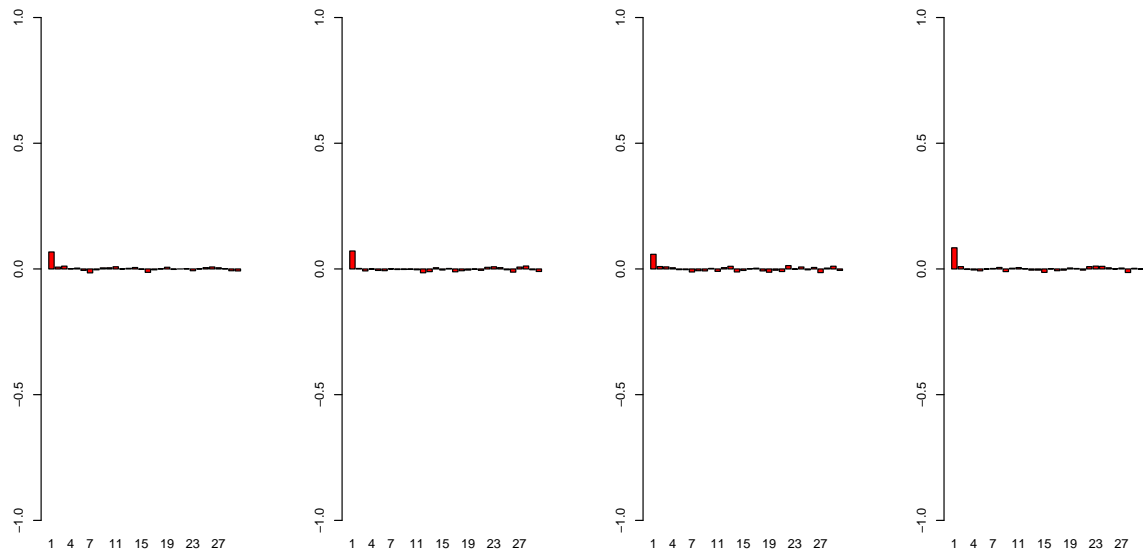




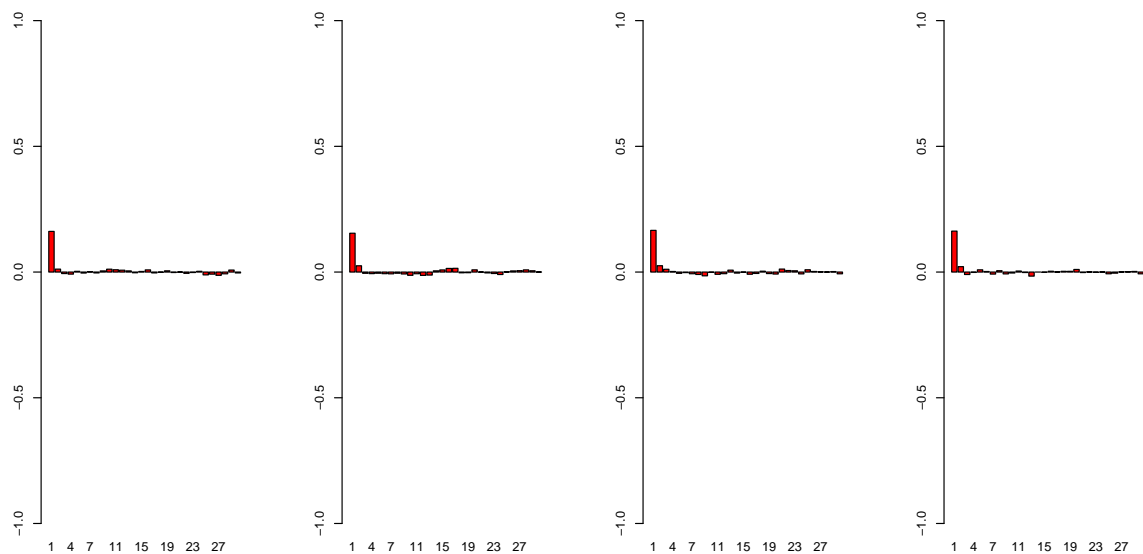
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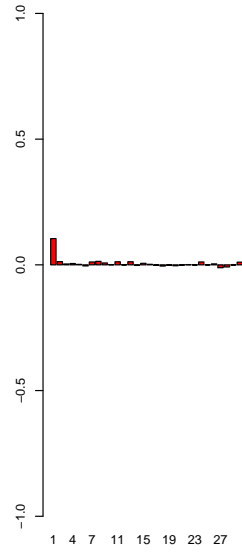
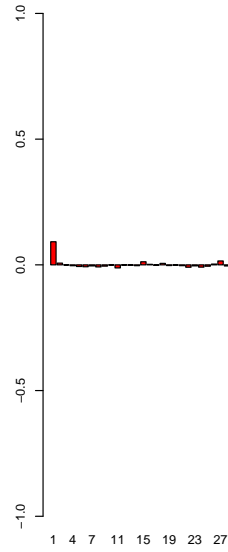
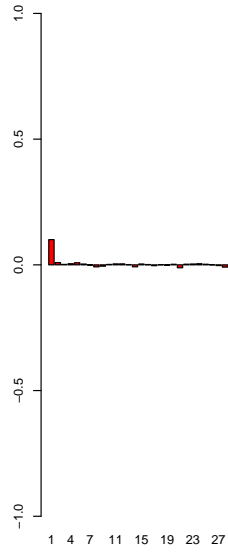
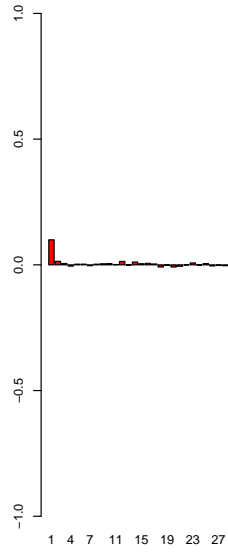
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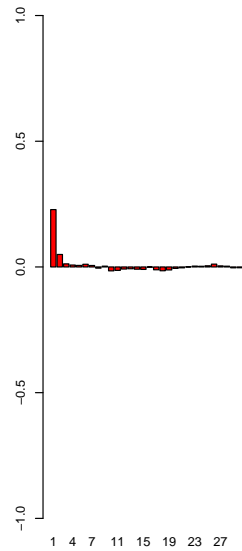
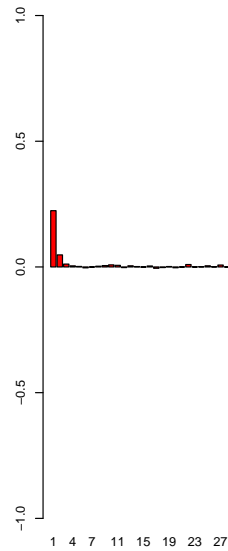
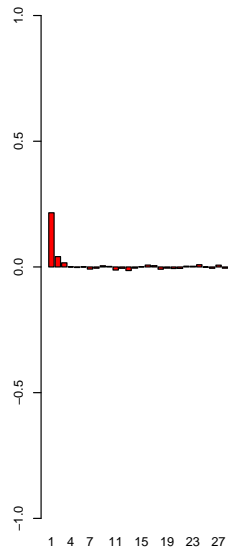
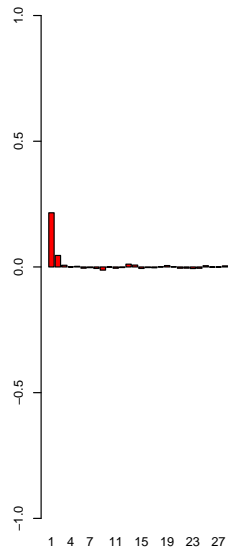
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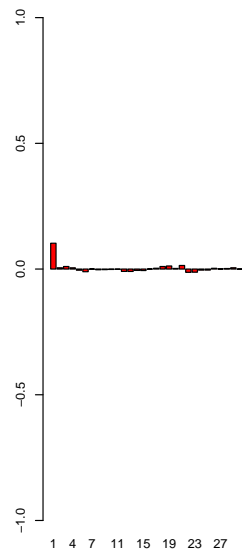
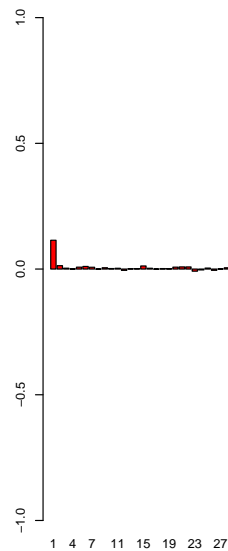
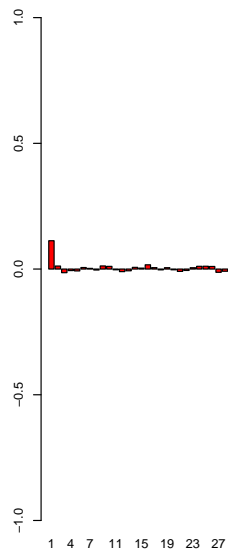
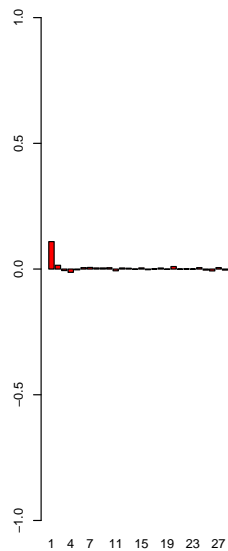
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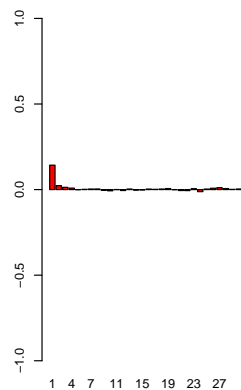
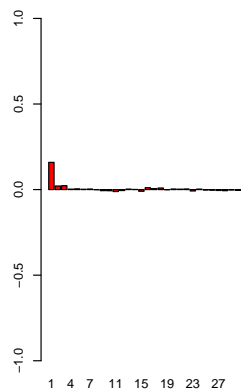
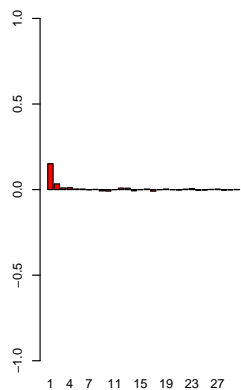
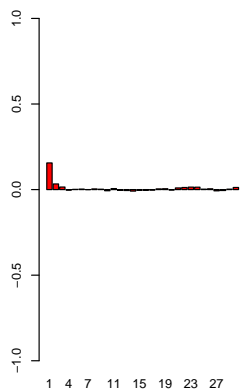
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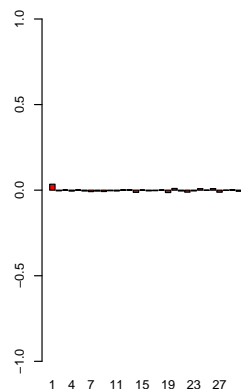
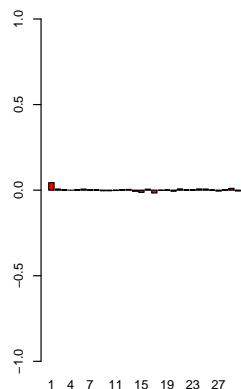
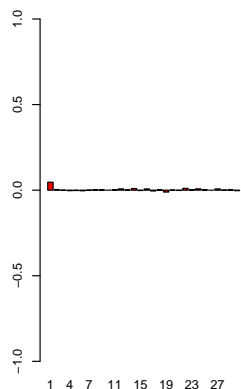
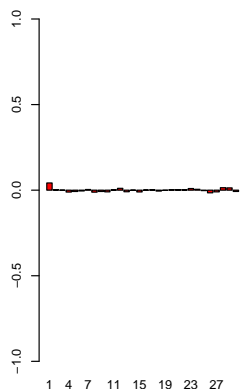
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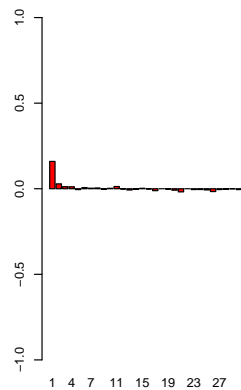
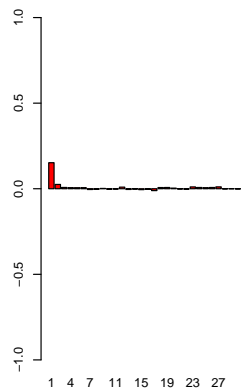
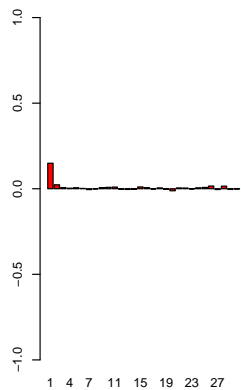
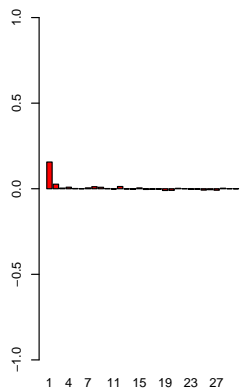
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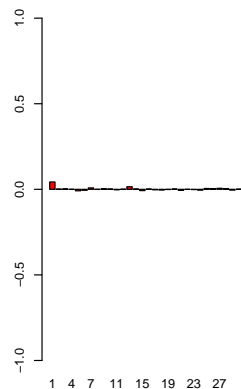
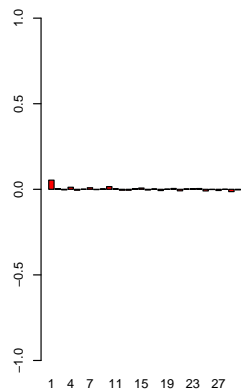
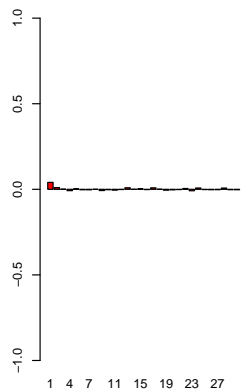
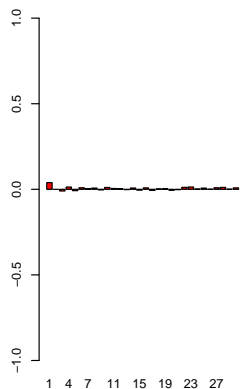
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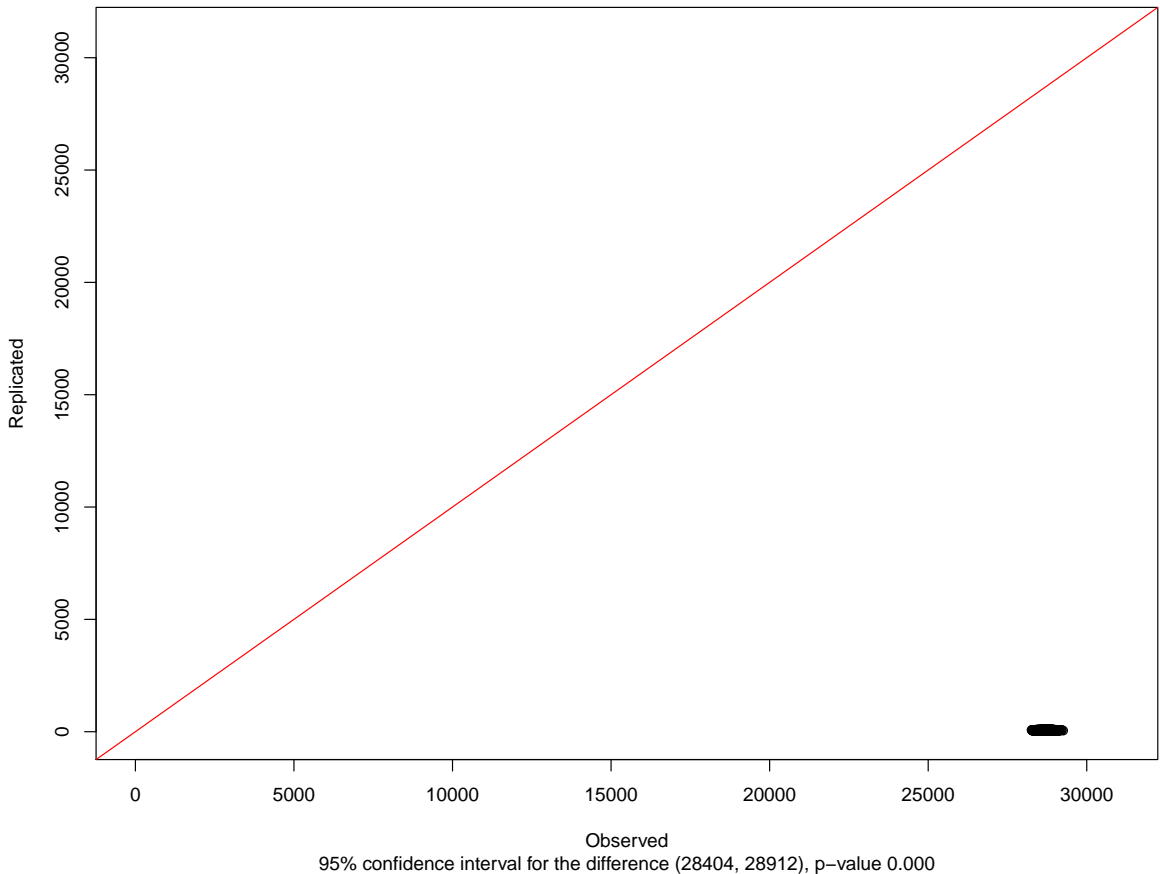
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Parameter 22, %BETWEEN%: EDUSHO Parameter 22, %BETWEEN%: EDUSHO Parameter 22, %BETWEEN%: EDUSHO Parameter 22, %BETWEEN%: EDUSHO



Bayesian Predictive Scatter Plot



Bayesian Predictive Distribution

