Factors Affecting Well-being: An analysis using the Panel Study of Income Dynamics

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BIOS 512 Final Project

4/16/15

Overview

- Motivation
- Descriptive statistics/graphics
- Statistical methods
- Results and conclusions

Motivation

- Goal
  - How different characteristics and behaviors influence an individual's overall wellbeing
- Panel Data
  - Years of data collection: 2005, 2007, 2009, 2011
  - N=2,149
  - Total number of observations: 5,290
    - Avg. data points per person: 1.99

Data points/year:

year	N
2005	742
2007	1104
2009	1546
2011	1898
Total	5290

Data points/Person:

count	Freq.	Percent	Cum.
1	2,149	40.62	40.62
2	1,570	29.68	70.30
3	1,023	19.34	89.64
4	548	10.36	100.00
Total	5,290	100.00	

Dataset

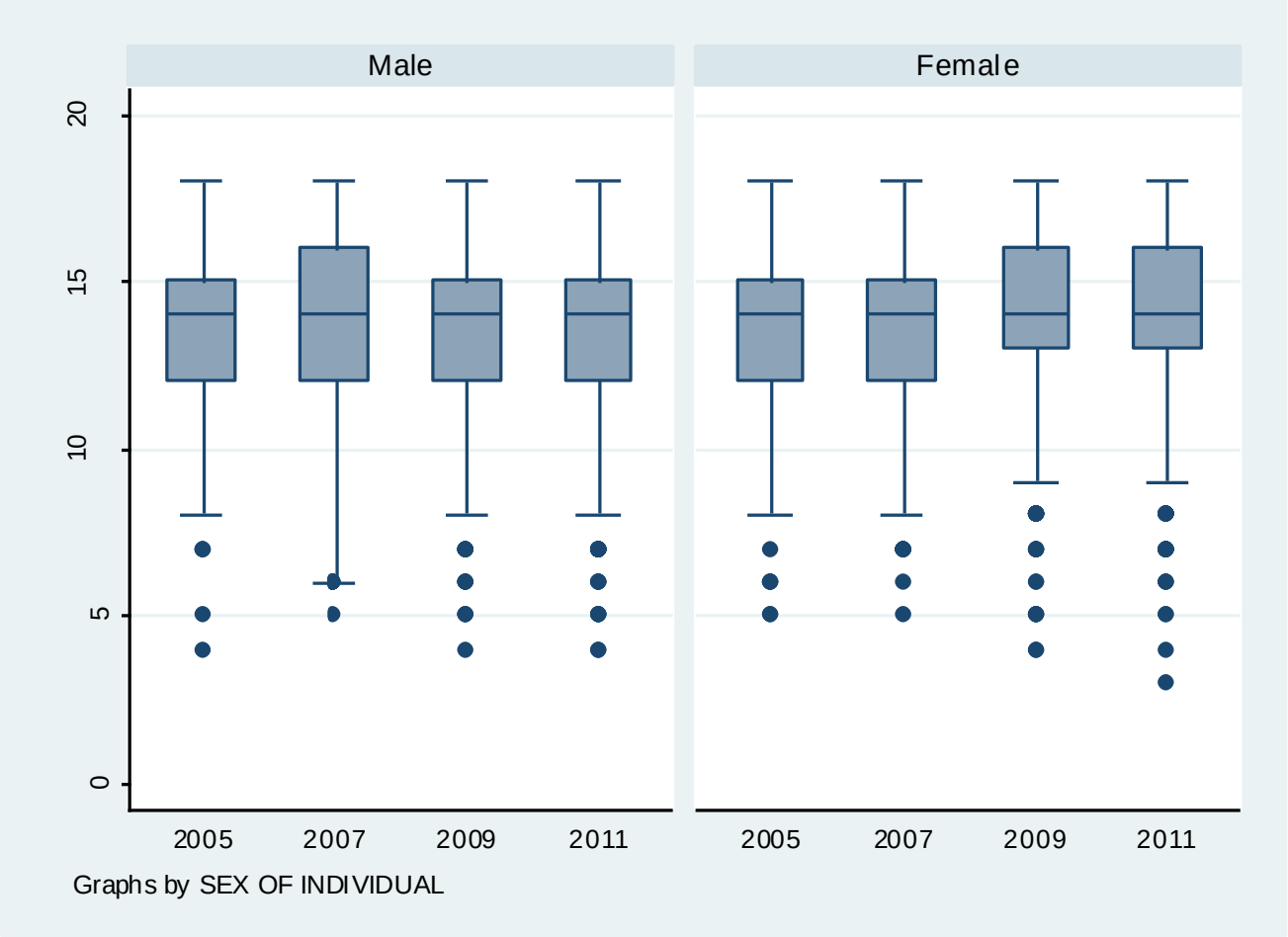
Variable Description	Type of variable
Level 1 Variables: Time-Varying	
Respondent's **age** at time of interview	Continuous
Indicator for whether or not respondent **volunteered** during the current year, collected each year	Binary
Frequency of **volunteer** activity, collected each year	Categorical, 0-6
Self reported **health**, collected each year	Categorical, 1-5
How often respondent engages in **vigorous activity**, collected each year	Categorical, 1-6
How often respondent engages in **light activity**, collected each year	Categorical, 1-6
Indicator of whether respondent currently **smokes**, collected each year	Binary
Indicator of whether respondent currently drinks **alcoho**l, collected each year	Binary
Indicator on whether respondent considers themselves **spiritual**, collected yearly	Binary
Internet use score calculated using several **internet use** measures, collected each year	Continuous
Level 2 Variables: Time Invariant	
Unique ID	
Sex of the individual	1=Male 2=Female
Respondent's race	1=White 2=Black 3=Other
Respondent's baseline BMI	Continuous
Dependent Variable	
Respondent's overall well-being score	Continuous

Descriptive Statistics

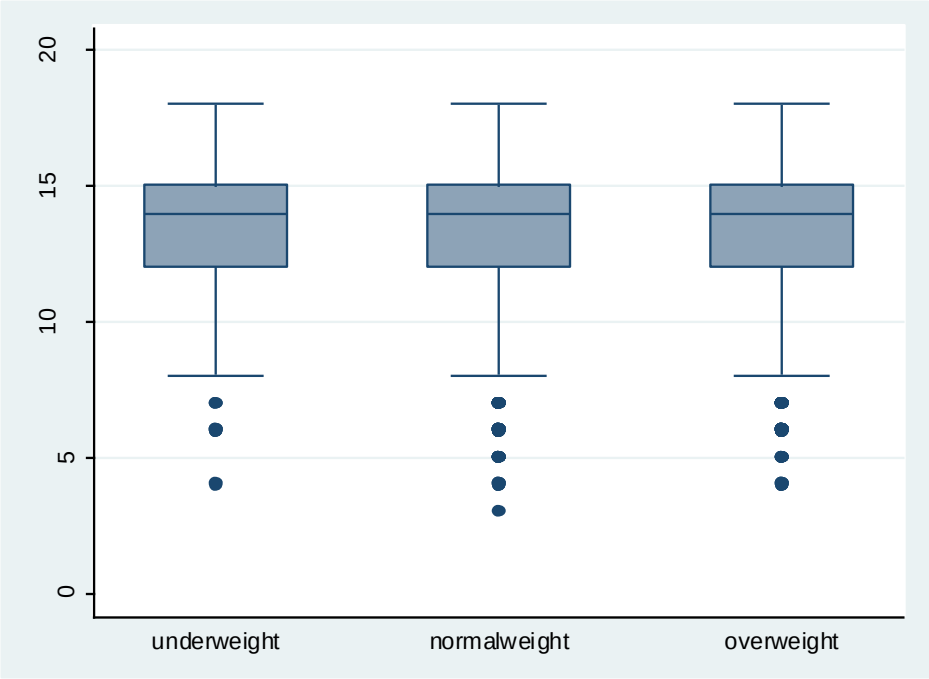
- Insert table of means of key variables

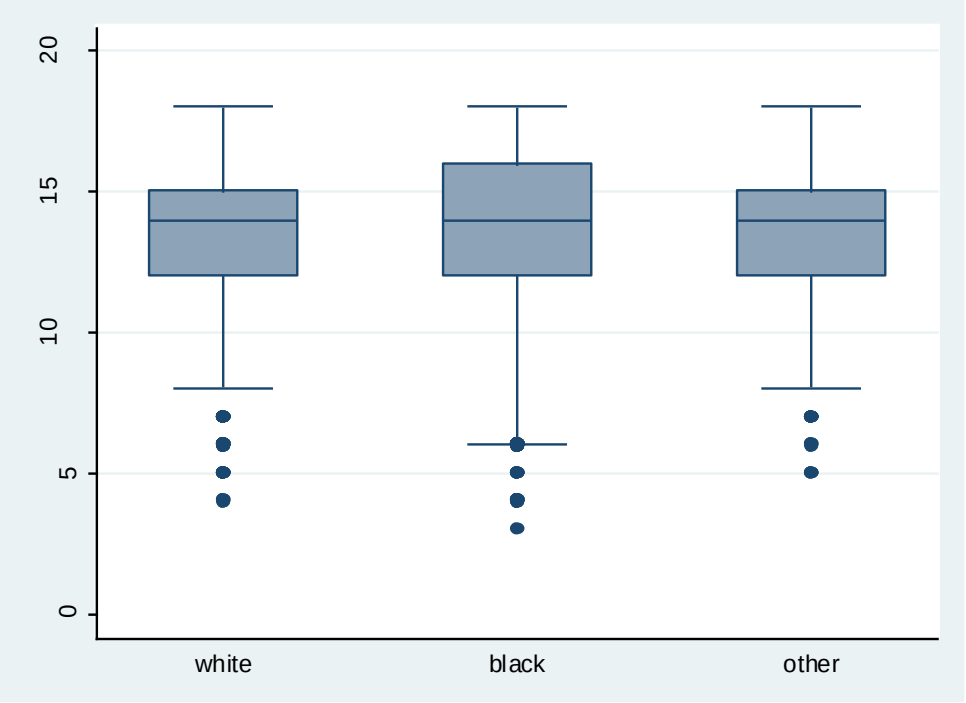
variable	N	mean	sd	min	max
id	5290	1066.429	619.3611	1	2155
year	5290	2008.739	2.108783	2005	2011
sex	5290	1.524197	.4994614	1	2
age	5290	20.83592	2.444142	17	27
vol	5288	.288767	.4532323	0	1
volfreq	5289	.6606164	1.218693	0	6
health	5281	2.193145	.9096486	1	5
vigact	3603	2.426311	1.672954	1	6
lightact	3606	2.127011	1.515507	1	6
smoke	5282	.2260507	.418312	0	1
alcohol	5276	.6347612	.4815427	0	1
spirit	5274	.593667	.4911947	0	1
wb	5290	13.68885	2.515817	3	18
intuse	5289	10.70902	3.996055	0	24
race	5282	1.56418	.6167428	1	3
bmi	5281	24.80949	5.179625	15.3	53.9

Graphics (1): Overall Well-being, by year and sex



Graphics(2): Box Plots over Level 2 Variables

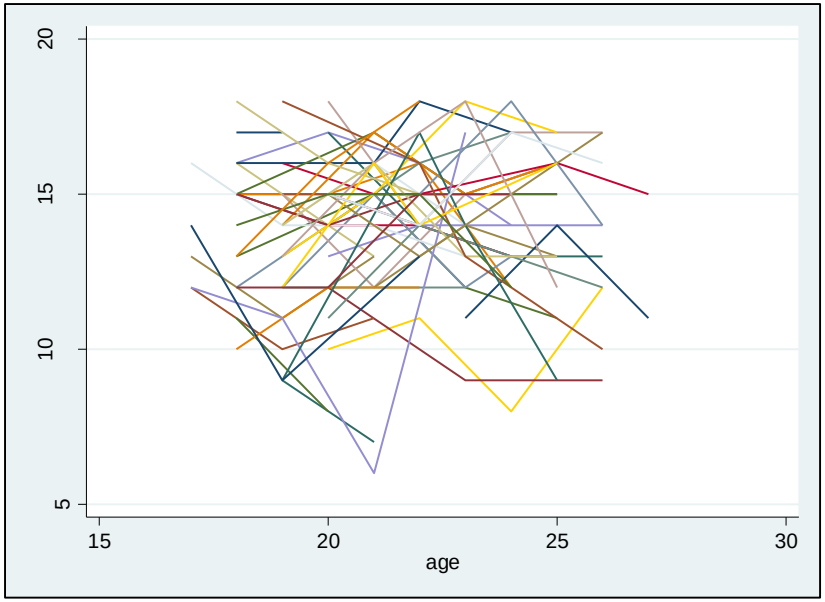




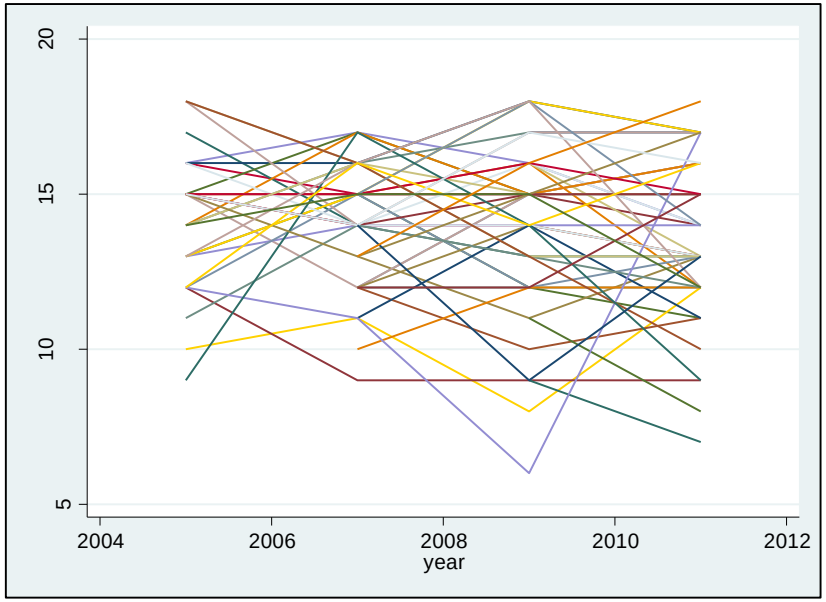
Fitting the Model

- Aims:
  - How much does well-being vary within person over time? (i.e. How important is time as a predictor of well-being?)
  - Which variables are significant predictors of variation in well-being?
  - What is the effect of adding level 2 predictors?
  - Should this be a linear mixed or marginal model?

The effect of time on well-being



Age in subsample
Coefficient = 0.0004306
P=0.995



Year in subsample
Coefficient = -0.05534
P=0.404

TOP-DOWN MODEL FITTING APPROACH

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2417476	.0798385	3.03	0.002	.085267	.3982282
health						
Excellent	2.274034	.4290645	5.30	0.000	1.433083	3.114985
Very Good	1.915622	.4251971	4.51	0.000	1.082251	2.748993
Good	1.382367	.4266634	3.24	0.001	.5461225	2.218612
Fair	.8186175	.4330127	1.89	0.059	-.0300719	1.667307
spirit	.5983863	.0813799	7.35	0.000	.4388845	.757888
smoke	-.5180348	.1075342	-4.82	0.000	-.728798	-.3072716
alcohol	-.070909	.0819648	-0.87	0.387	-.231557	.0897389
intuse	.0742208	.0104606	7.10	0.000	.0537185	.0947232
exercise						
light exercise	-.2680714	.2323816	-1.15	0.249	-.723531	.1873883
vigorous exercise	-.1499956	.2972821	-0.50	0.614	-.7326578	.4326666
light&vigorous exercise	-.1526725	.1784377	-0.86	0.392	-.502404	.1970591
year	.0348463	.0161423	2.16	0.031	.0032079	.0664847
sex						
Female	.1714925	.0985712	1.74	0.082	-.0217036	.3646885
race						
black	-.0096109	.1063096	-0.09	0.928	-.2179738	.198752
other	-.4156497	.1897003	-2.19	0.028	-.7874554	-.043844
BMICat						
normalweight	.1737495	.1926648	0.90	0.367	-.2038665	.5513655
overweight	.3639268	.1981846	1.84	0.066	-.0245078	.7523614
_cons	-59.24208	32.41018	-1.83	0.068	-122.7649	4.280714

ICC and R^2 Values

ICC Values	
Null Model	0.53887
Final Model	0.48224

R^2 Values	
Addition of level 1 compared to null	+ 0.78%
Addition of level 2 compared to level 1	+0.57%

LMM VS. MARGINAL MODEL

Marginal Model vs. LMM

Comparing covariance matrix structures in the marginal model:

Covariance Matrix Structure	**AIC**	**BIC**
Unstructured	23040.89	23218.2
Compound Symmetric	23041.65	23166.42
Toeplitz, 1, 2, 3	-no convergence	-
AR-1	-no convergence	-

Comparing the marginal model with linear matrix model fit:

Model	**AIC**	**BIC**
Marginal Model (unstructured)	23041.65	23166.42
Linear Mixed Model	23034.14	23152.34

FINAL MODEL

Final Model

$$Wb_{t,\,id} = \beta_0 + \beta_1(excellent) + \beta_2(verygood) + \beta_3(good) + \beta_4(fair) + \beta_5(spirit) + \beta_6(smoke) + \beta_7(intuse) + \beta_8(exercise\_binary) + \beta_9(sex) + \beta_{10}(black) + \beta_{11}(other) + \beta_{12}(normalweight) + \beta_{13}(overweight) + \beta_{14}(centbaseage) + \beta_{15}(centyear) + b_{0id} + \varepsilon_{t,id}$$

$$b_{0id} \sim N(0, \sigma^2_{intercepts}),\ \varepsilon_{t,id} \sim N(0, \sigma^2_{error})$$

$\varepsilon_{t,id}$ and b_{0id} are independent

Final Model: Regression Output

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2690381	.0687574	3.91	0.000	.1342762	.4038001
health						
Excellent	2.087576	.3499693	5.97	0.000	1.401649	2.773503
Very Good	1.758287	.3465477	5.07	0.000	1.079066	2.437508
Good	1.336157	.3467464	3.85	0.000	.6565471	2.015768
Fair	.8861372	.3519783	2.52	0.012	.1962725	1.576002
spirit	.5666083	.0676984	8.37	0.000	.4339219	.6992947
smoke	-.5450757	.0860225	-6.34	0.000	-.7136767	-.3764747
intuse	.0674678	.0082594	8.17	0.000	.0512797	.083656
1.exercise_binary	-.1495332	.1721561	-0.87	0.385	-.4869531	.1878866
sex						
Female	.2375147	.0887758	2.68	0.007	.0635174	.411512
race						
black	-.0057229	.0942832	-0.06	0.952	-.1905145	.1790688
other	-.3608464	.1765968	-2.04	0.041	-.7069698	-.0147229
BMICat						
normalweight	.1403612	.1740851	0.81	0.420	-.2008392	.4815617
overweight	.2796972	.1791765	1.56	0.119	-.0714822	.6308767
centbaseage	.0012582	.035174	0.04	0.971	-.0676815	.0701979
centyear	.0358163	.0125052	2.86	0.004	.0113066	.060326
_cons	10.75806	.4262369	25.24	0.000	9.922653	11.59347

Final Model: Interpretation(1)

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2690381	.0687574	3.91	0.000	.1342762	.4038001
health						
Excellent	2.087576	.3499693	5.97	0.000	1.401649	2.773503
Very Good	1.758287	.3465477	5.07	0.000	1.079066	2.437508
Good	1.336157	.3467464	3.85	0.000	.6565471	2.015768
Fair	.8861372	.3519783	2.52	0.012	.1962725	1.576002
spirit	.5666083	.0676984	8.37	0.000	.4339219	.6992947
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intuse	.0674678	.0082594	8.17	0.000	.0512797	.083656
1.exercise_binary	-.1495332	.1721561	-0.87	0.385	-.4869531	.1878866
sex						
Female	.2375147	.0887758	2.68	0.007	.0635174	.411512
race						
black	-.0057229	.0942832	-0.06	0.952	-.1905145	.1790688
other	-.3608464	.1765968	-2.04	0.041	-.7069698	-.0147229
BMICat						
normalweight	.1403612	.1740851	0.81	0.420	-.2008392	.4815617
overweight	.2796972	.1791765	1.56	0.119	-.0714822	.6308767
centbaseage	.0012582	.035174	0.04	0.971	-.0676815	.0701979
centyear	.0358163	.0125052	2.86	0.004	.0113066	.060326
_cons	**10.75806**	**.4262369**	**25.24**	**0.000**	**9.922653**	**11.59347**

Final Model: Interpretation (2)

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2690381	.0687574	3.91	0.000	.1342762	.4038001
health						
Excellent	2.087576	.3499693	5.97	0.000	1.401649	2.773503
Very Good	1.758287	.3465477	5.07	0.000	1.079066	2.437508
Good	1.336157	.3467464	3.85	0.000	.6565471	2.015768
Fair	.8861372	.3519783	2.52	0.012	.1962725	1.576002
spirit	.5666083	.0676984	8.37	0.000	.4339219	.6992947
smoke	-.5450757	.0860225	-6.34	0.000	-.7136767	-.3764747
intuse	.0674678	.0082594	8.17	0.000	.0512797	.083656
1.exercise_binary	-.1495332	.1721561	-0.87	0.385	-.4869531	.1878866
sex						
Female	.2375147	.0887758	2.68	0.007	.0635174	.411512
race						
black	-.0057229	.0942832	-0.06	0.952	-.1905145	.1790688
other	-.3608464	.1765968	-2.04	0.041	-.7069698	-.0147229
BMICat						
normalweight	.1403612	.1740851	0.81	0.420	-.2008392	.4815617
overweight	.2796972	.1791765	1.56	0.119	-.0714822	.6308767
centbaseage	.0012582	.035174	0.04	0.971	-.0676815	.0701979
centyear	.0358163	.0125052	2.86	0.004	.0113066	.060326
_cons	10.75806	.4262369	25.24	0.000	9.922653	11.59347

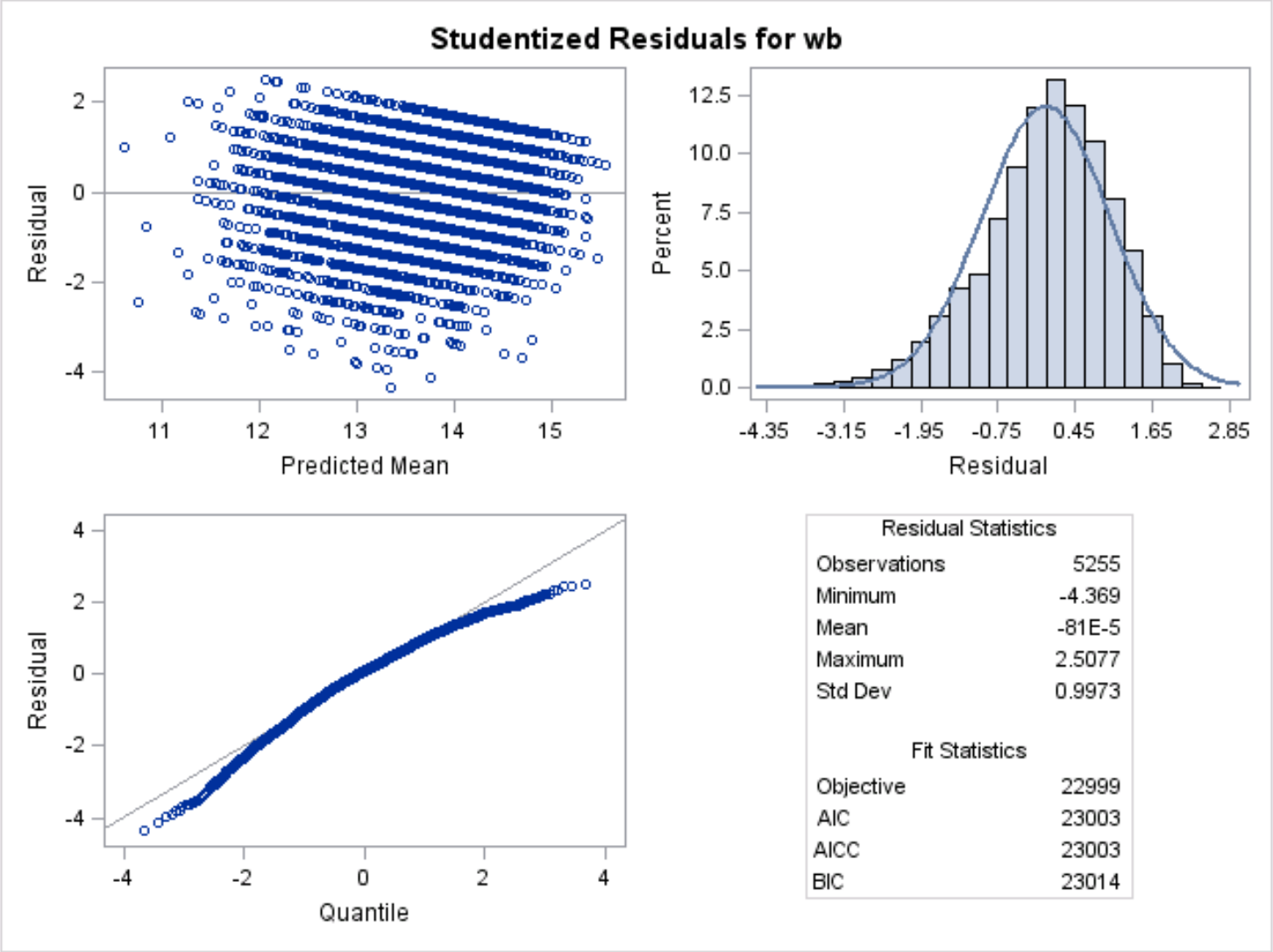
Final Model: Interpretation (3)

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2690381	.0687574	3.91	0.000	.1342762	.4038001
health						
Excellent	2.087576	.3499693	5.97	0.000	1.401649	2.773503
Very Good	1.758287	.3465477	5.07	0.000	1.079066	2.437508
Good	1.336157	.3467464	3.85	0.000	.6565471	2.015768
Fair	.8861372	.3519783	2.52	0.012	.1962725	1.576002
spirit	.5666083	.0676984	8.37	0.000	.4339219	.6992947
smoke	-.5450757	.0860225	-6.34	0.000	-.7136767	-.3764747
intuse	.0674678	.0082594	8.17	0.000	.0512797	.083656
1.exercise_binary	-.1495332	.1721561	-0.87	0.385	-.4869531	.1878866
sex						
Female	.2375147	.0887758	2.68	0.007	.0635174	.411512
race						
black	-.0057229	.0942832	-0.06	0.952	-.1905145	.1790688
other	-.3608464	.1765968	-2.04	0.041	-.7069698	-.0147229
BMICat						
normalweight	.1403612	.1740851	0.81	0.420	-.2008392	.4815617
overweight	.2796972	.1791765	1.56	0.119	-.0714822	.6308767
centbaseage	.0012582	.035174	0.04	0.971	-.0676815	.0701979
centyear	.0358163	.0125052	2.86	0.004	.0113066	.060326
_cons	10.75806	.4262369	25.24	0.000	9.922653	11.59347

Final Model: Interpretation (4)

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2690381	.0687574	3.91	0.000	.1342762	.4038001
health						
Excellent	2.087576	.3499693	5.97	0.000	1.401649	2.773503
Very Good	1.758287	.3465477	5.07	0.000	1.079066	2.437508
Good	1.336157	.3467464	3.85	0.000	.6565471	2.015768
Fair	.8861372	.3519783	2.52	0.012	.1962725	1.576002
spirit	.5666083	.0676984	8.37	0.000	.4339219	.6992947
smoke	-.5450757	.0860225	-6.34	0.000	-.7136767	-.3764747
intuse	.0674678	.0082594	8.17	0.000	.0512797	.083656
1.exercise_binary	-.1495332	.1721561	-0.87	0.385	-.4869531	.1878866
sex						
Female	.2375147	.0887758	2.68	0.007	.0635174	.411512
race						
black	-.0057229	.0942832	-0.06	0.952	-.1905145	.1790688
other	-.3608464	.1765968	-2.04	0.041	-.7069698	-.0147229
BMICat						
normalweight	.1403612	.1740851	0.81	0.420	-.2008392	.4815617
overweight	.2796972	.1791765	1.56	0.119	-.0714822	.6308767
centbaseage	.0012582	.035174	0.04	0.971	-.0676815	.0701979
centyear	.0358163	.0125052	2.86	0.004	.0113066	.060326
_cons	10.75806	.4262369	25.24	0.000	9.922653	11.59347

Model diagnostics



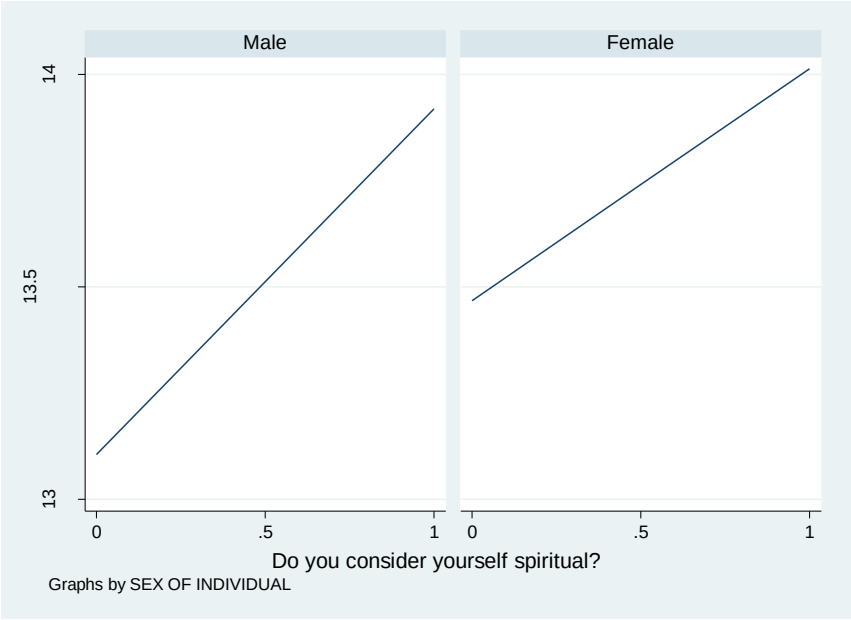
Residual Statistics	
Observations	5255
Minimum	-4.369
Mean	-81E-5
Maximum	2.5077
Std Dev	0.9973

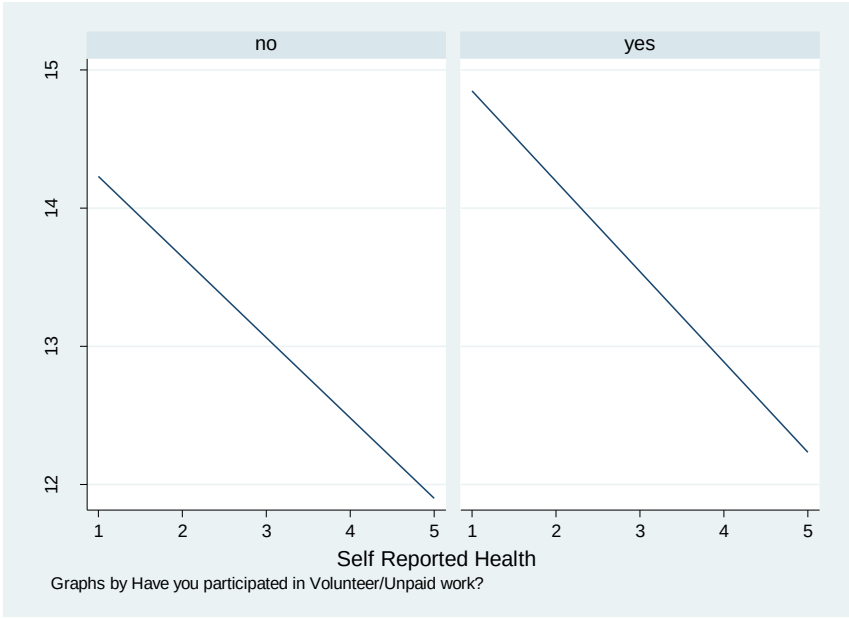
Fit Statistics	
Objective	22999
AIC	23003
AICC	23003
BIC	23014

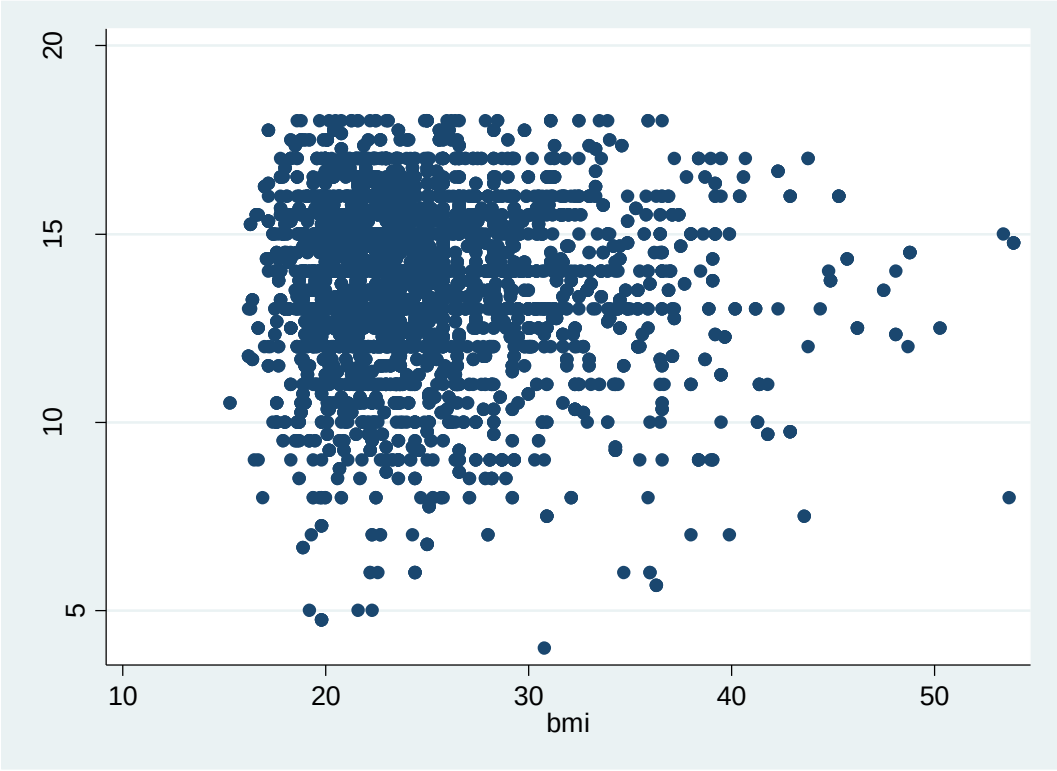
APPENDIX

Interaction terms tested

Interaction term	Effect size	P-value
Centage*spirit	0.0071	0.767
BMICat##exercise_binary	-0.25, 0.049	0.665, 0.933
Centage*smoke	0.0104	0.706
Vol*health	-0.104	0.135
Spirit*health	0.0183	0.782
Spirit*sex	-.239	0.073
Vol*sex	-0.174	0.197
Year*sex	0.0203	0.412


Male
Female
14
13.5
13
0
.5
1
Do you consider yourself spiritual?
Graphs by SEX OF INDIVIDUAL


no
yes
15
14
13
12
1
2
3
4
5
Self Reported Health
Graphs by Have you participated in Volunteer/Unpaid work?


20
15
10
5
10
20
30
40
50
bmi

Regression output: level 1 only

wb	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vol	.2698057	.0685253	3.94	0.000	.1354986	.4041128
health						
Excellent	2.059678	.350224	5.88	0.000	1.373252	2.746105
Very Good	1.747954	.346988	5.04	0.000	1.06787	2.428038
Good	1.330808	.3472754	3.83	0.000	.650161	2.011455
Fair	.9031456	.3524965	2.56	0.010	.2122652	1.594026
spirit	.5824274	.0670793	8.68	0.000	.4509544	.7139004
smoke	-.5544362	.0856537	-6.47	0.000	-.7223144	-.386558
exercise_binary	-.1615787	.1718866	-0.94	0.347	-.4984703	.1753129
intuse	.0665583	.0082477	8.07	0.000	.0503931	.0827236
year	.0354707	.0125022	2.84	0.005	.0109669	.0599746
_cons	-60.05425	25.10563	-2.39	0.017	-109.2604	-10.84813

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
id: Identity				
var(_cons)	2.72756	.1316283	2.481399	2.998142
var(Residual)	2.920724	.0741609	2.778929	3.069754

LR test vs. linear regression: chibar2(01) = 964.21 Prob >= chibar2 = 0.0000

Appendix-1: ICC and R-square

- ICC-Null model

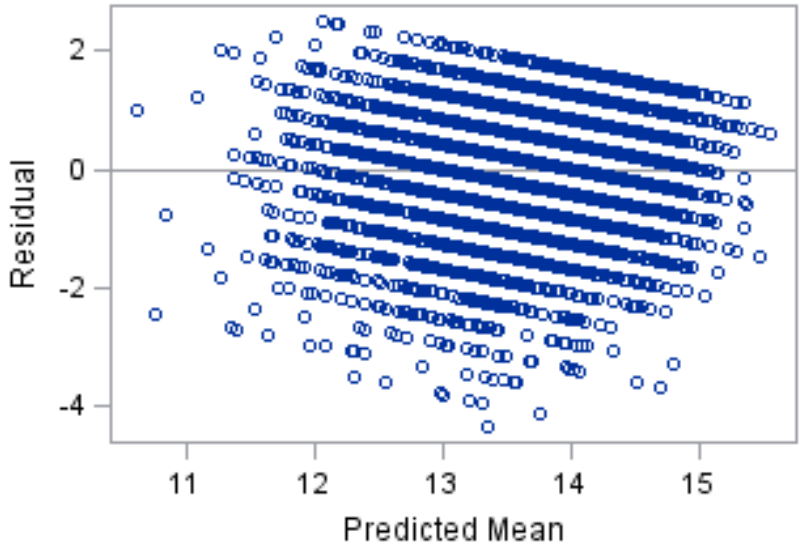
Obs	CovParm	Subject	Estimate	bvar	icc
1	Intercept	id	3.4401	3.44008	.
2	Residual		2.9438	3.44008	0.53887

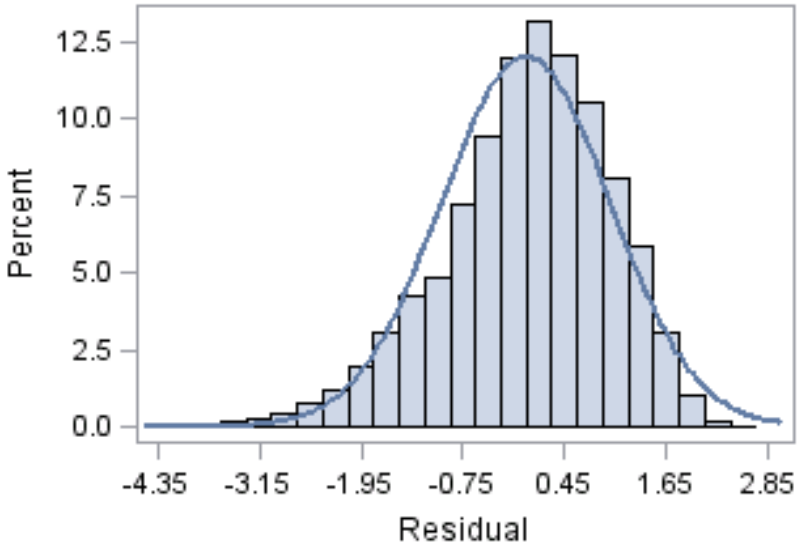
- ICC-Final model

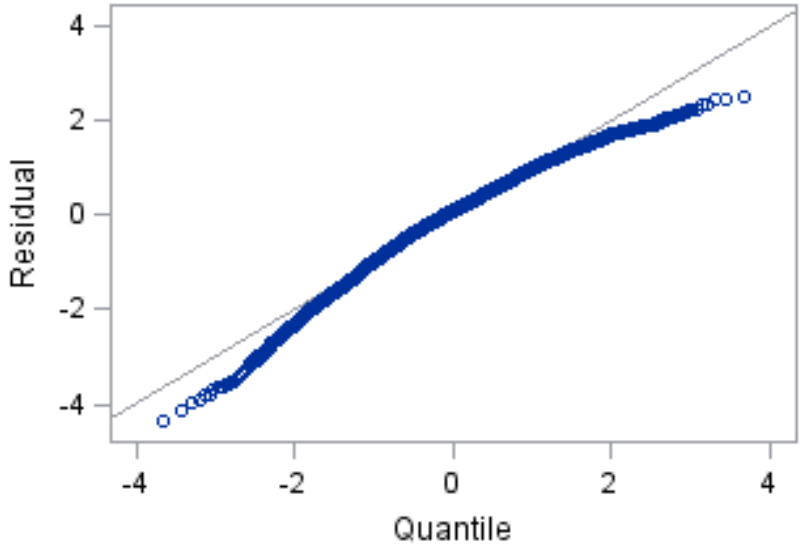
- R-square

	model1(null)	model2(level 1)	model3(level 2)
error	2.9438	2.9207	2.9117
intercept	3.4401	2.7275	2.7120

Studentized Residuals for wb



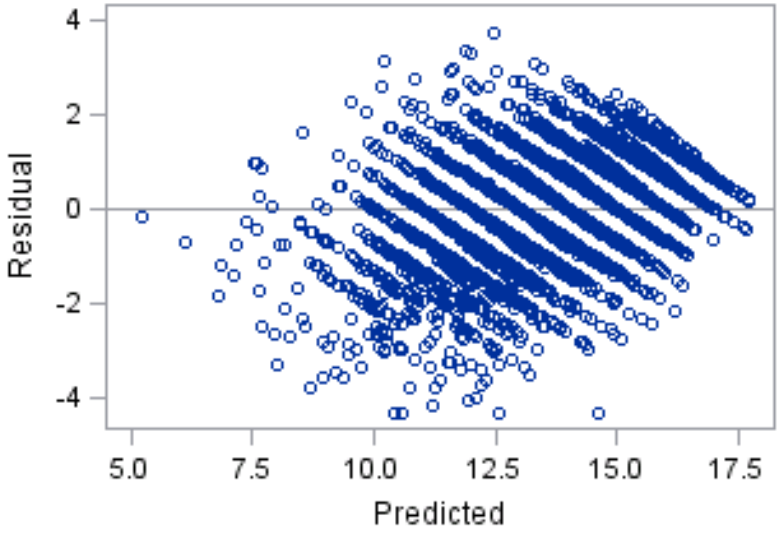


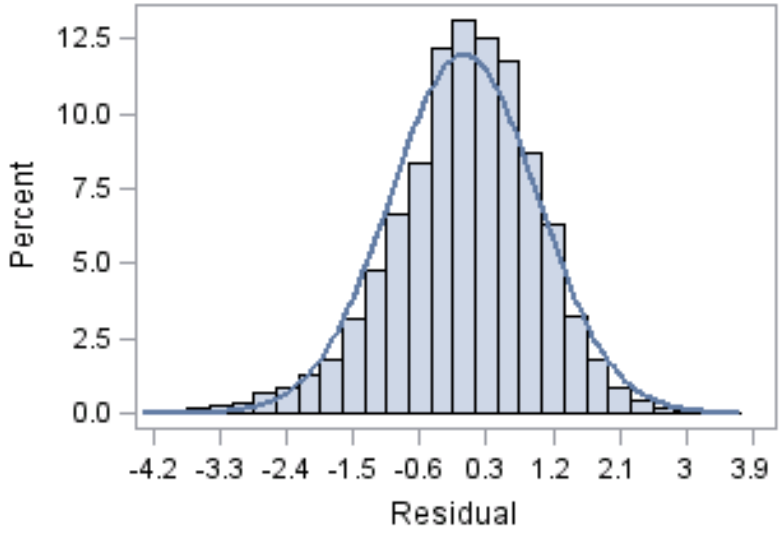


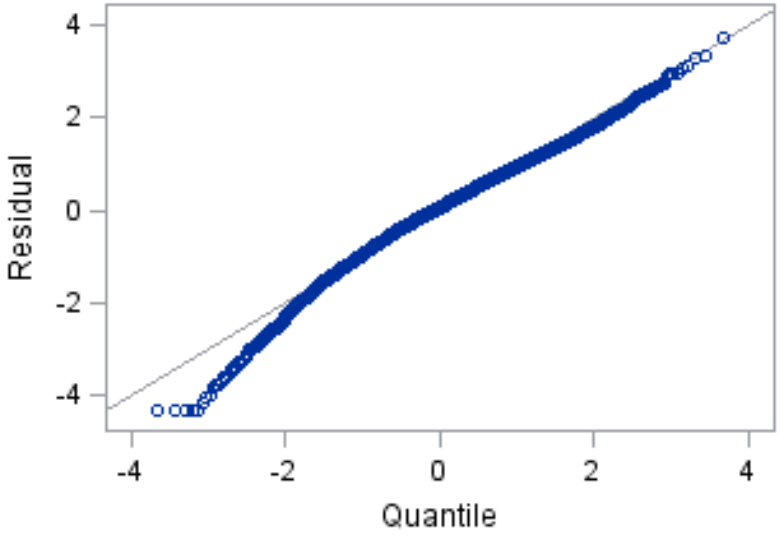
Residual Statistics	
Observations	5255
Minimum	-4.369
Mean	-81E-5
Maximum	2.5077
Std Dev	0.9973

Fit Statistics	
Objective	22999
AIC	23003
AICC	23003
BIC	23014

Conditional Studentized Residuals for wb

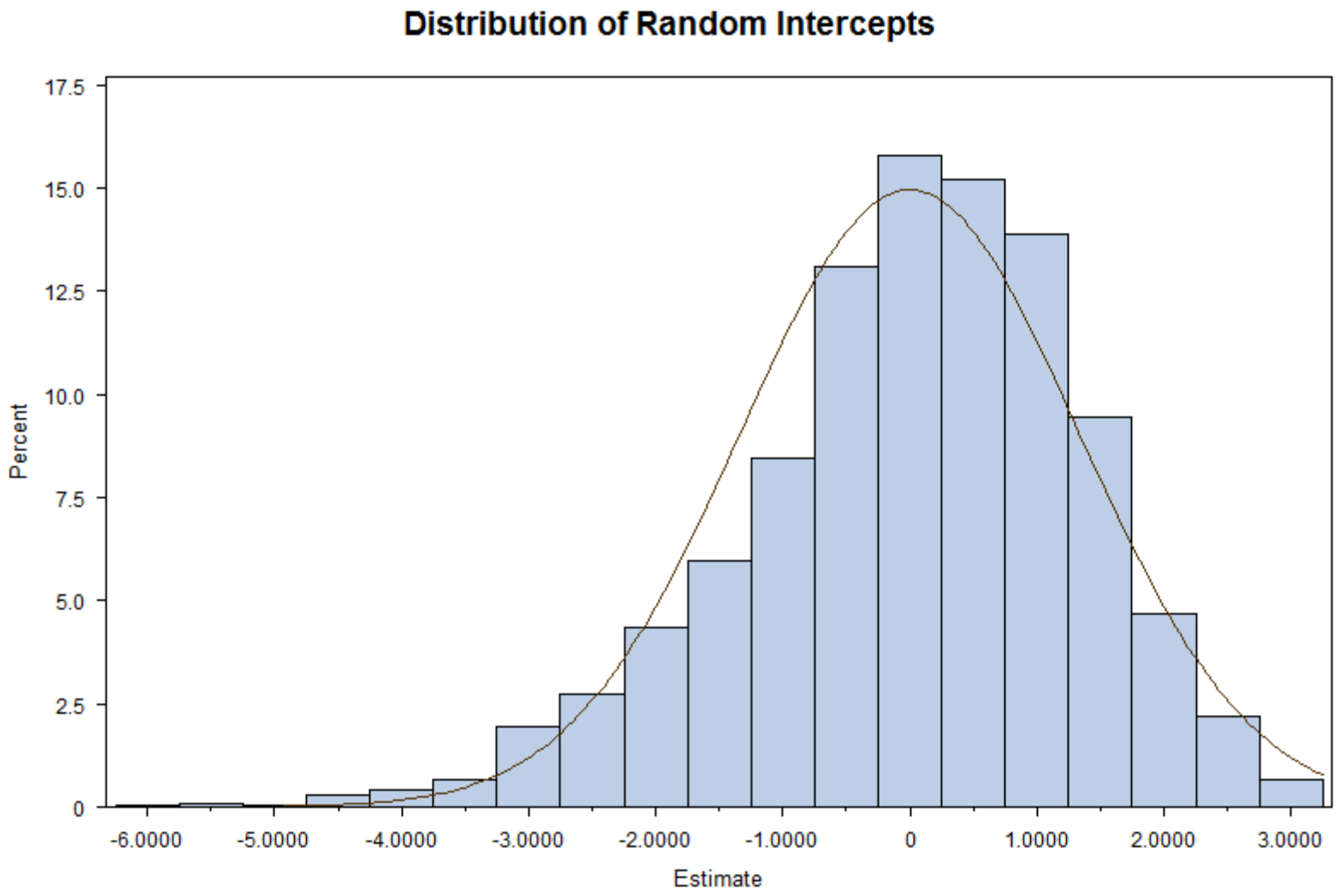


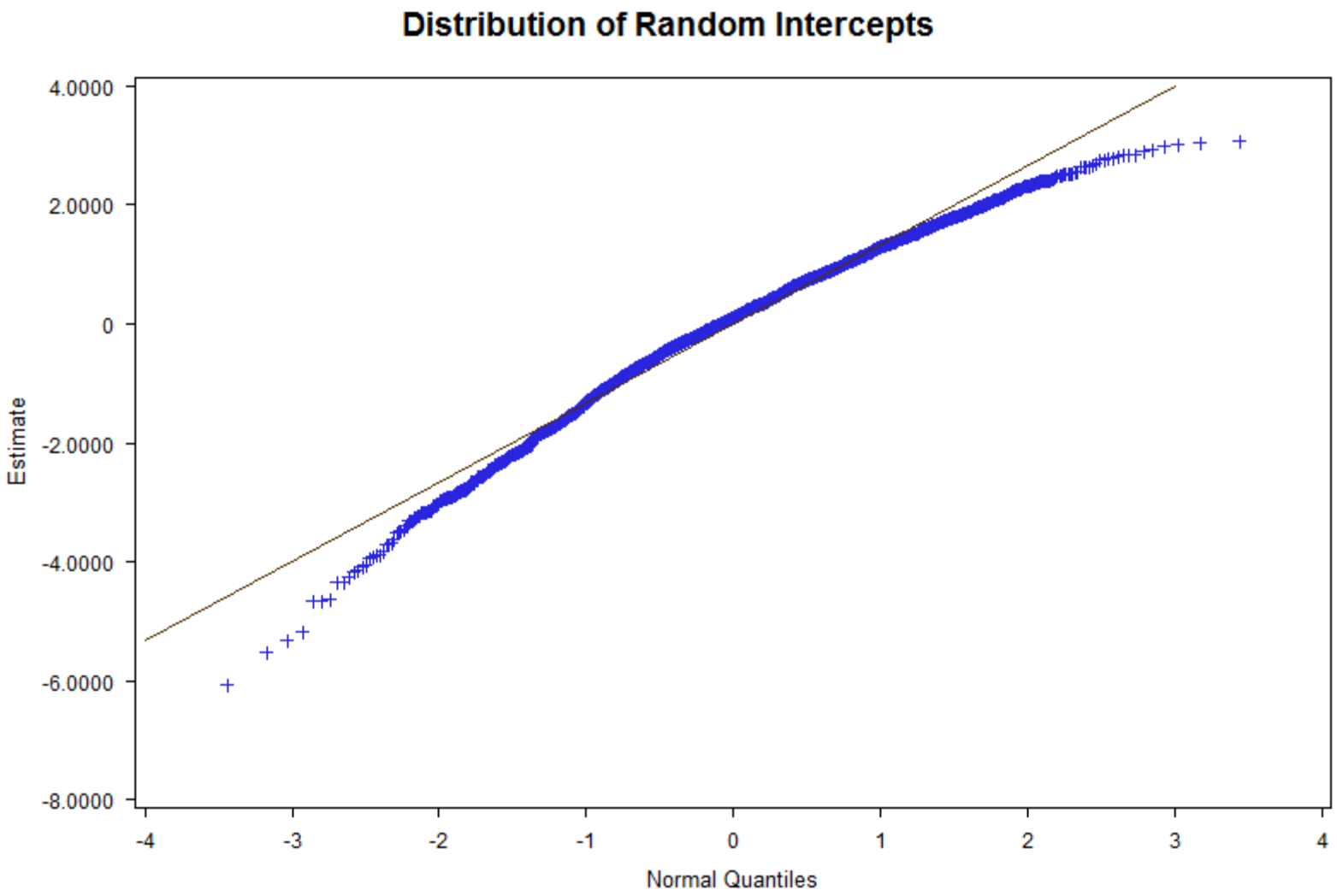




Residual Statistics	
Observations	5255
Minimum	-4.337
Mean	91E-7
Maximum	3.7293
Std Dev	1.0006

Fit Statistics	
Objective	22999
AIC	23003
AICC	23003
BIC	23014


Distribution of Random Intercepts
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0
Percent
-6.0000
-5.0000
-4.0000
-3.0000
-2.0000
-1.0000
0
1.0000
2.0000
3.0000
Estimate


Distribution of Random Intercepts
4.0000
2.0000
0
-2.0000
-4.0000
-6.0000
-8.0000
Estimate
-4
-3
-2
-1
0
1
2
3
4
Normal Quantiles

Tests for random slope

Level 1 vs. Level 2?

Mean(wb) - BMI