

Univariate Analysis

Mx class 2004



Univariate Genetic Analysis

- Saturated Models

- Free variances, covariances
- Free means

- Univariate Models

- Variances partitioned in a, c/d and e
- Free means (or not)



Practical Example

- Dataset: NH&MRC Twin Register
- 1981 questionnaire
- BMI: weight/ height squared
- Young cohort: 18-30 years
- N MZFY: 534, DZFY: 328

Raw Dataset ozbmi.rec

115 21 1 2 58 57 1.7000 1.7000 20.0692 19.7232 20.9943 20.8726
121 24 1 2 54 53 1.6299 1.6299 20.3244 19.9481 21.0828 20.9519
158 21 1 2 55 50 1.6499 1.6799 20.2020 17.7154 21.0405 20.1210
172 21 1 2 66 76 1.5698 1.6499 26.7759 27.9155 23.0125 23.3043
182 19 1 2 50 48 1.6099 1.6299 19.2894 18.0662 20.7169 20.2583
199 26 1 2 60 60 1.5999 1.5698 23.4375 24.3418 22.0804 22.3454
221 23 1 2 65 65 1.7500 1.7698 21.2245 20.7476 21.3861 21.2270
239 29 1 2 40 39 1.5598 1.5298 16.4366 16.6603 19.5966 19.6912
246 24 1 2 60 57 1.7598 1.7698 19.3698 18.1940 20.7460 20.3076
251 28 1 2 76 64 1.7000 1.7300 26.2976 21.3839 22.8863 21.4385
262 29 1 2 48 51 1.5198 1.5698 20.7756 20.6905 21.2365 21.2077
284 19 1 2 70 67 1.6799 1.6799 24.8016 23.7387 22.4764 22.1697
524 20 1 2 53 50 1.6199 1.6299 20.1951 18.8189 21.0381 20.5440
535 22 1 2 57 55 1.5798 1.5999 22.8329 21.4844 21.8974 21.4713
582 26 1 2 62 61 1.6799 1.6399 21.9671 22.6800 21.6268 21.8504
587 28 1 2 60 58 1.6299 1.6399 22.5827 21.5645 21.8203 21.4974
588 19 1 2 55 55 1.5698 1.5698 22.3133 22.3133 21.7363 21.7363
621 21 1 2 46 49 1.5698 1.5498 18.6620 20.3954 20.4854 21.1072
630 27 1 1 54 55 1.7698 . 17.2364 . 19.9292 .
631 28 1 2 58 60 1.6899 1.6899 20.3074 21.0077 21.0769 21.3142

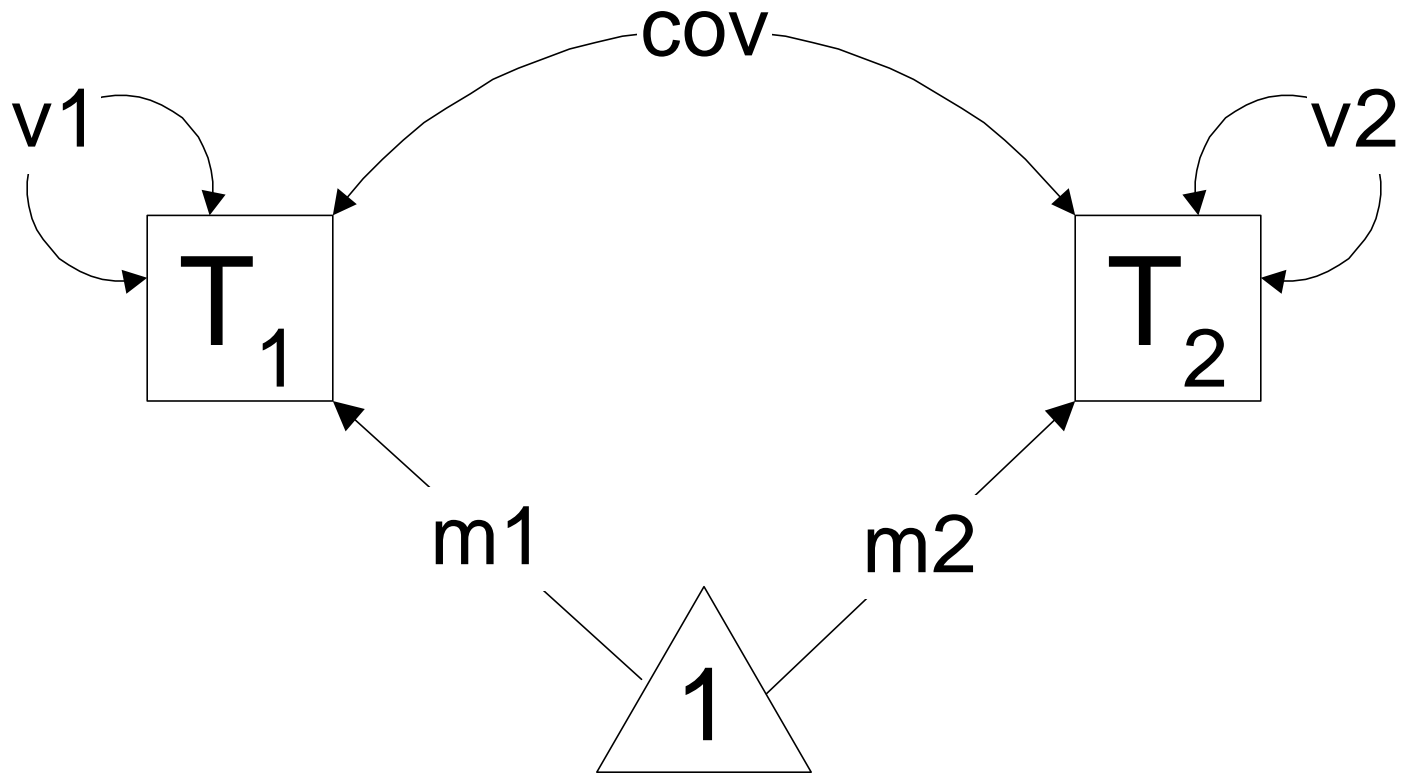
Zygoty in Australian Twins

	MZF	MZM	DZF	DZM	DZFM
Young	1	2	3	4	5
Old	6	7	8	9	10

Dat File: ozbmi.dat

- Data NInput=12
- Rectangular File=ozbmi.rec
- Labels fam age zyg part wt1 wt2 ht1 ht2
htwt1 htwt2 bmi1 bmi2

Saturated Model



! Estimate means and variances - Saturated model

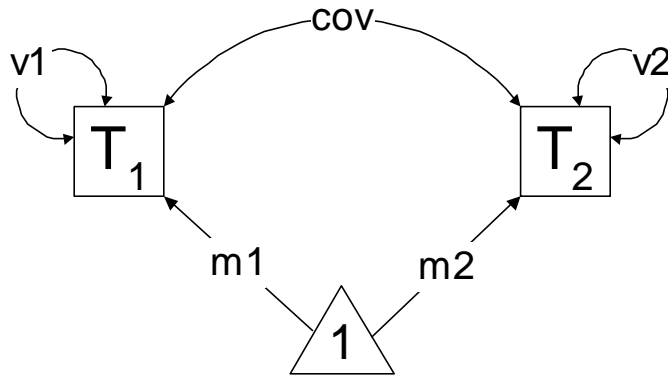
! OZ BMI data - young females

- #NGroups 2
 - #define nvar2 2

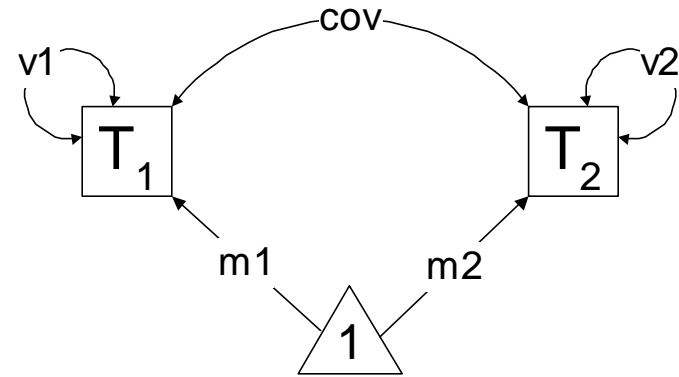
 - Title 1: MZ data
 - #include ozbmi.dat
 - Select if zyg =1
 - Select bmi 1 bmi 2 ;
 - Begin Matrices;
 - M Full 1 nvar2 Free
 - X Symm nvar2 nvar2 Free
 - End Matrices;
 - Start 20 M 1 1 - M 1 nvar2
 - Start 1 X 1 1 X 2 2
 - Means M;
 - Covariance X;
 - Option RSiduals
 - End
- Title 2: DZ data
 - #include ozbmi.dat
 - Select if zyg =3
 - Select bmi 1 bmi 2 ;
 - Begin Matrices;
 - M Full 1 nvar2 Free
 - X Symm nvar2 nvar2 Free
 - End Matrices;
 - Start 20 M 1 1 - M 1 nvar2
 - Start 1 X 1 1 X 2 2
 - Means M;
 - Covariance X;
 - Option RSiduals
 - End

ozbmifysat.mx

Equality of means, variances



MZ twins



DZ twins

10 parameters

Tests

- Saturated model
- Equality of means
 - Is $m_1 = m_2$?
 - Is $m_{1MZ} = m_{1DZ}$?
- Equality of variances
 - Is $v_1 = v_2$?
 - Is $v_{1MZ} = v_{1DZ}$?

Equality tests

-
 - Option Multiple Issat
 - End

 - Save ozbmi sat. mxs
 - ! equate means and variances
 - Equate M 1 1 1 M 1 1 2 M 2 1 1 M 2 1 2
 - Equate X 1 1 1 X 1 2 2 X 2 1 1 X 2 2 2
 - End
- Get ozbmi sat. mxs
 - ! equate means within zygoty groups
 - Equate M 1 1 1 M 1 1 2
 - Equate M 2 1 1 M 2 1 2
 - End

 - ! equate means across zygoty groups
 - Equate M 1 1 1 M 1 1 2 M 2 1 1 M 2 1 2
 - End

 - ! equate variances within zygoty groups
 - Equate X 1 1 1 X 1 2 2
 - Equate X 2 1 1 X 2 2 2
 - End

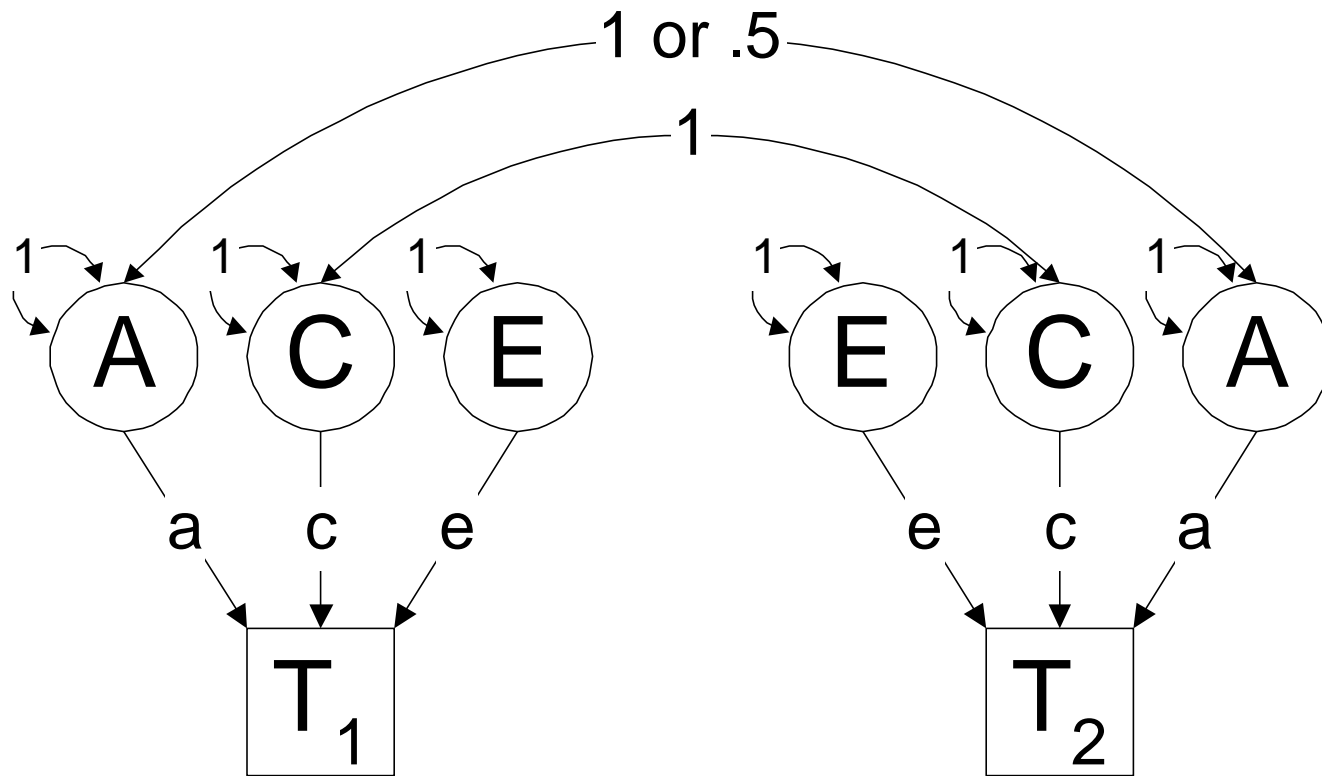
 - ! equate variances across zygoty groups
 - Equate X 1 1 1 X 1 2 2 X 2 1 1 X 2 2 2
 - End

ozbmifysateqmv.mx

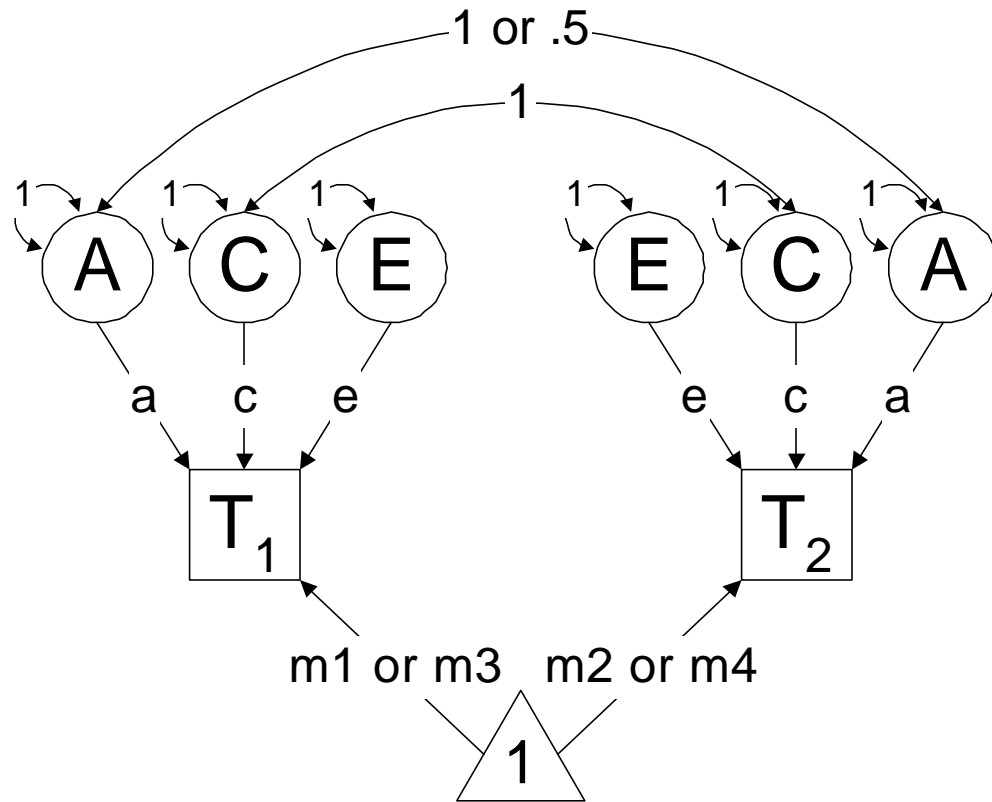
Multiple Fit

	MZ (group 1)					DZ (group 2)					par
	m1	m2	v1	cov	v2	m3	m4	v3	cov	v4	
Full	1	2	3	4	5	6	7	8	9	10	10
Save filename.mxs: 10 free parameters											10
I	1	1	3	4	3	1	1	3	9	3	4
Get filename.mxs: back to 10 free parameters											10
II	1	1	3	4	5	6	6	8	9	10	8
III	1	1	3	4	5	1	1	8	9	10	7
IV	1	1	3	4	3	1	1	8	9	8	5
V	1	1	3	4	3	1	1	3	9	3	4

ACE Model



ACE Model + Means



Tests

- ACE model
- Is a significant ? -> CE model
- Is c significant ? -> AE model
- Is there significant family resemblance ?
-> E model

- ADE model

! Estimate variance components - ACED model

! OZ BMI data - younger females

- #NGroups 4
- #define nvar 1
- #define nvar2 2
- Title 1: Model Parameters
- Calculation
- Begin Matrices;
- X Lower nvar nvar Free ! a
- Y Lower nvar nvar ! c
- Z Lower nvar nvar Free ! e
- W Lower nvar nvar Free ! d
- H Full 1 1 ! 0.5
- Q Full 1 1 ! 0.25
- End Matrices;
- Matrix H .5
- Matrix Q .25
- Label Row X add_gen
- Label Row Y com_env
- Label Row Z spec_env
- Label Row W dom_gen
- Begin Algebra;
- A= X*X' ; ! a^2
- C= Y*Y' ; ! c^2
- E= Z*Z' ; ! e^2
- D= W*W' ; ! d^2
- End Algebra;
- End

! Estimate variance components - ACED model

! OZ BMI data - younger females II

- Title 2: MZ data
- #include ozbmi.dat
- Select if zyg =1
- Select bmi 1 bmi 2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- Means M;
- Covariance
- A+C+E+D | A+C+D _
- A+C+D | A+C+E+D;
- Option RSiduals;
- End

- Title 3: DZ data
- #include ozbmi.dat
- Select if zyg =3
- Select bmi 1 bmi 2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- End Matrices;
- Means M;
- Covariance
- A+C+E+D | H@A+C+Q@D _
- H@A+C+Q@D | A+C+E+D;
- Option RSiduals
- End

! Estimate variance components - ACED model

! OZ BMI data - younger females III

- Title 4: Standardization
- Calculation
- Begin Matrices = Group 1;
- End Matrices;
- Start .6 all
- Start 20 M 2 1 1 - M 2 1 nvar2
- Start 20 M 3 1 1 - M 3 1 nvar2
- Begin Algebra;
- $V=A+C+E+D;$! total variance
- $P=A|C|E|D;$! concatenate parameter estimates
- $S=P@V~;$! standardized parameter estimates
- End Algebra;
- !ADE model
- Interval S 1 1 - S 1 4
- Option NDecimals=4
- Option Sat=4055.935, 1767
- End

ozbmifyace.mx

! Estimate variance components - ACED model

! OZ BMI data - younger females IV

- Title 4: Standardization
- Calculation
- Begin Matrices = Group 1;
- End Matrices;
- Start .6 all
- Start 20 M 2 1 1 - M 2 1 nvar2
- Start 20 M 3 1 1 - M 3 1 nvar2
- Begin Algebra;
- V=A+C+E+D;
- P=A|C|E|D;
- S=P@V~;
- End Algebra;
- !ADE model
- Interval S 1 1 - S 1 4
- Option NDecimals=4
- Option Sat=4055.935, 1767
- Option Multiple
- End
- !AE model
- Drop W 1 1 1
- End
- !ACE model
- Free Y 1 1 1
- End
- !CE model
- Drop X 1 1 1
- End
- !E model
- Drop Y 1 1 1
- End

ozbmifyaces.mx

Submodels: ozbmifyaces.mx

Matrix / Model	X (a)	Y (c)	Z (e)	W (d)	Cov NP	Mean NP	NP	DF
Sat					6	4	10	
ADE	Free		Free	Free		4	7	3
AE	Free		Free	Drop		4	6	4
ACE	Free	Free	Free			4	7	3
CE	Drop	Free	Free			4	6	4
E		Drop	Free			4	5	5

! Estimate variance components - ACED model

! OZ BMI data - younger females IV

- Title 4: Standardization
- Calculation
- Begin Matrices = Group 1;
- End Matrices;
- Start .6 all
- Start 20 M 2 1 1 - M 2 1 nvar2
- Start 20 M 3 1 1 - M 3 1 nvar2
- Begin Algebra;
- $V=A+C+E+D$;
- $P=A|C|E|D$;
- $S=P@V\sim$;
- End Algebra;
- !ADE model
- Interval S 1 1 - S 1 4
- Option NDecimals=4
- Option Sat=4055. 935, 1767
- Option Multiple
- End
- !Save ozbmi fy. mxs
- Option Issat
- End
- !AE model
- Drop W 1 1 1
- End
- !ACE model
- Free Y 1 1 1
- Option Sat=4055. 935, 1767
- End
- Option Issat
- End
- !CE model
- Drop X 1 1 1
- End
- !E model
- Drop Y 1 1 1
- End

ozbmifyaces2.mx

Submodels: ozbmifyaces2.mx

Matrix / Model	X (a)	Y (c)	Z (e)	W (d)	Cov NP	Mean NP	NP	Sat	DF
Sat #					6	4	10		
ADE \$	Free		Free	Free		4	7	10#	3
AE	Free		Free	Drop		4	6	7 \$	1
ACE &	Free	Free	Free			4	7	10#	3
CE	Drop	Free	Free			4	6	7 &	1
E		Drop	Free			4	5	7 &	2

Goodness-of-Fit

	-2LL	df	χ^2	df	p	AIC	$\Delta\chi^2$	df	p
Sat									
ADE				3					
AE				4				1	
ACE				3					
CE				4				1	
E				5				2	

Parameter Estimates

	a	c	e	d	a^2	c^2	e^2	d^2
Sat								
ADE								
AE								
ACE								
CE								
E								