



# Univariate Analysis

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# Files to Copy to your Computer

- Faculty/Maes/tc19/maes/univariate
  - ozbmi.rec
  - ozbmi.dat
  - ozbmiyface(s)(2).mx
  - Univariate.ppt



# Univariate Genetic Analysis

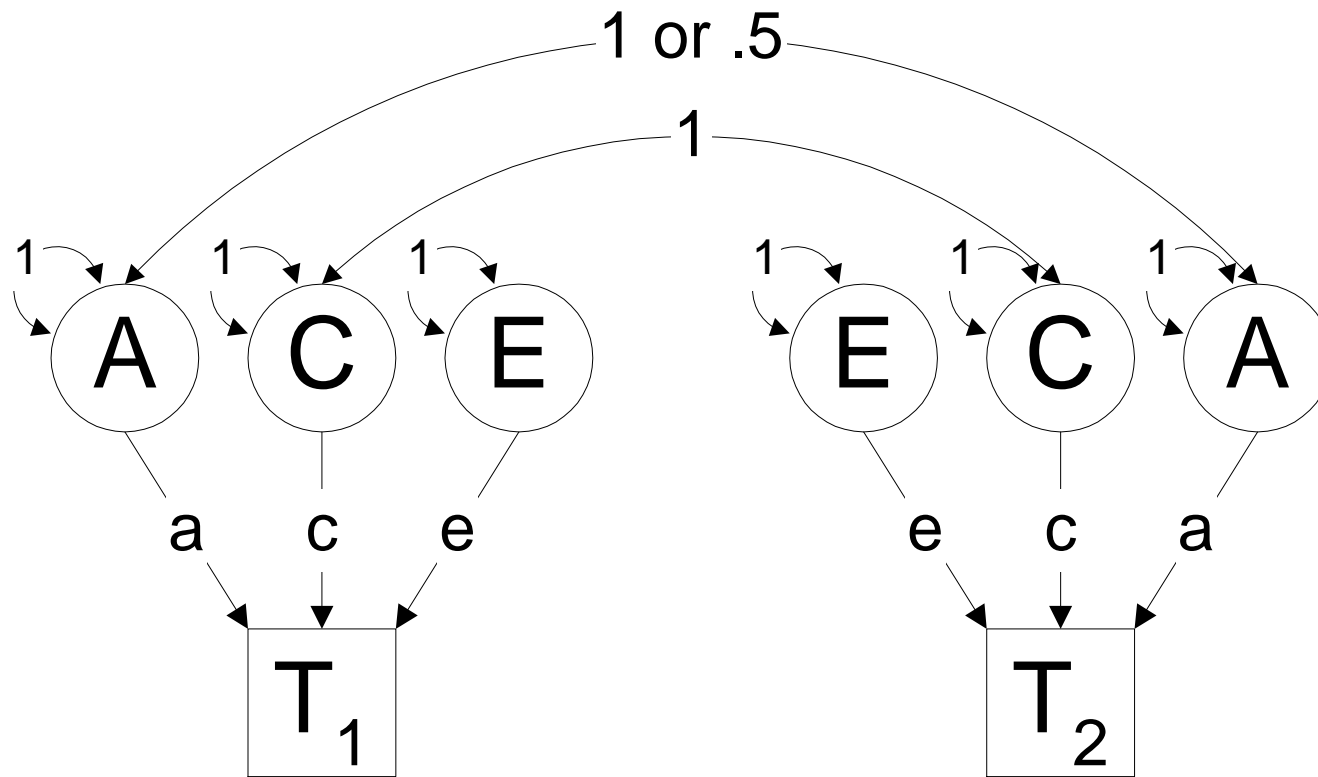
- Saturated Models

- Free variances, covariances
- Free means

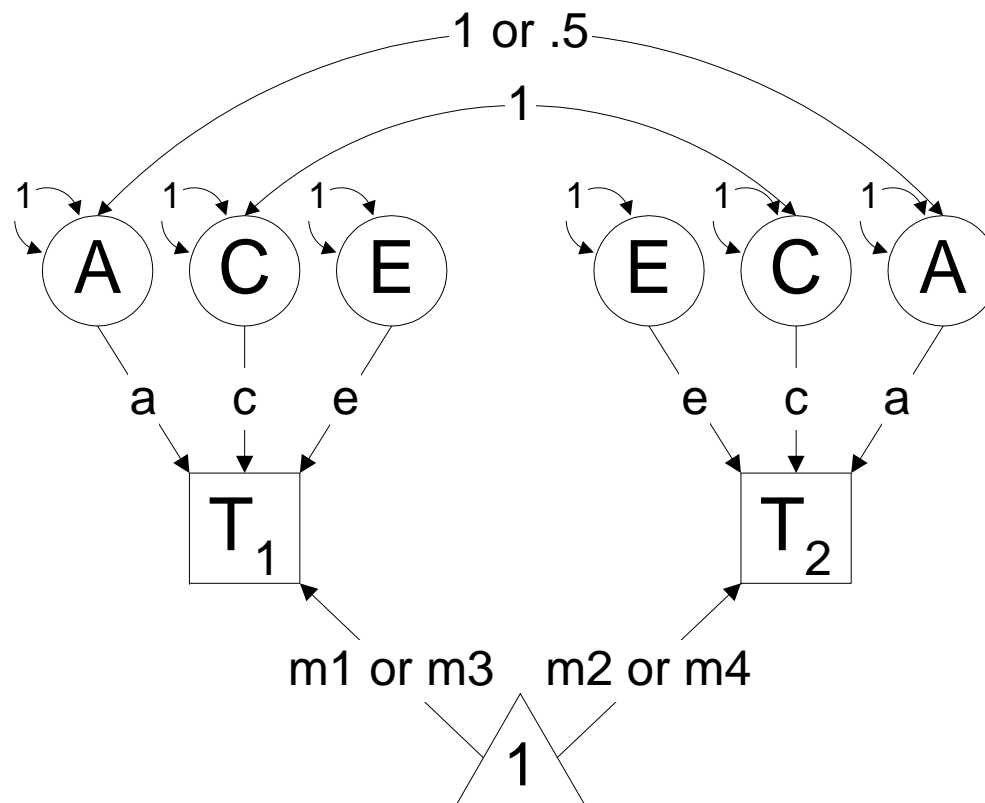
- Univariate Models

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

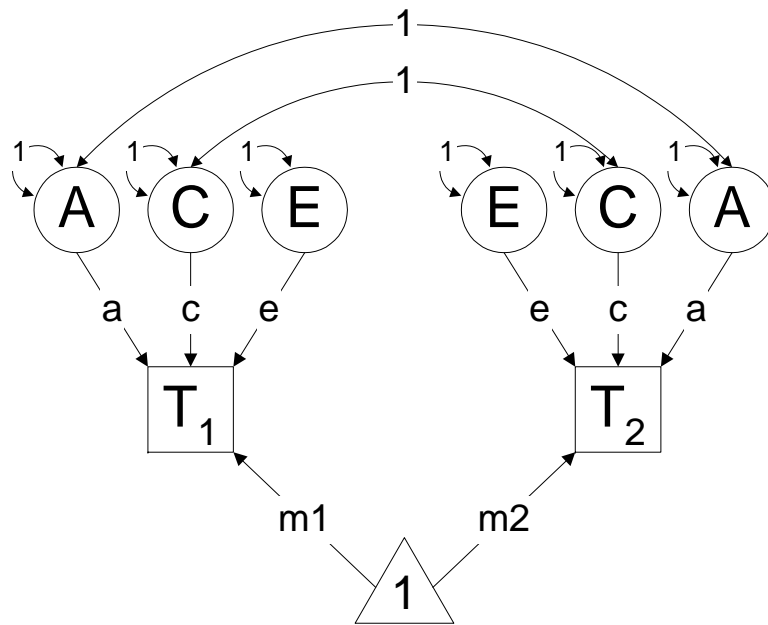
# ACE Model



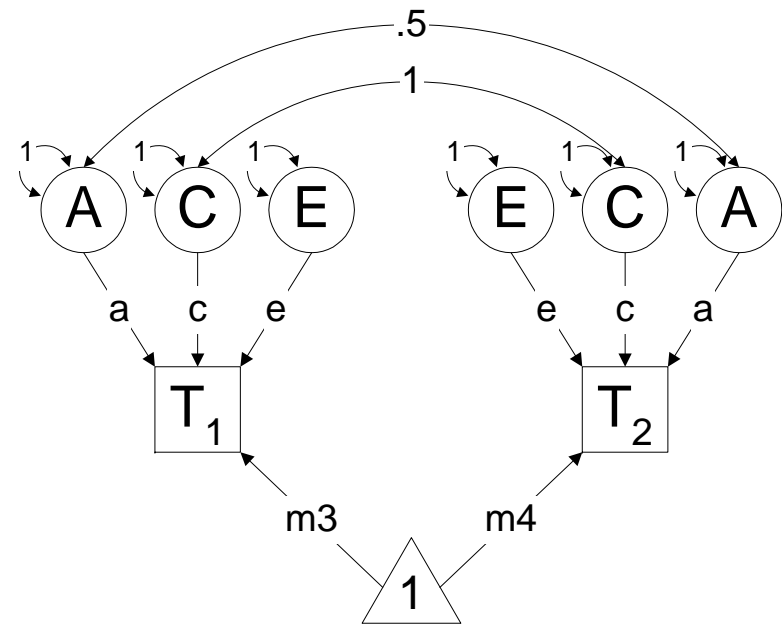
# ACE Model + Means



# ACE Model



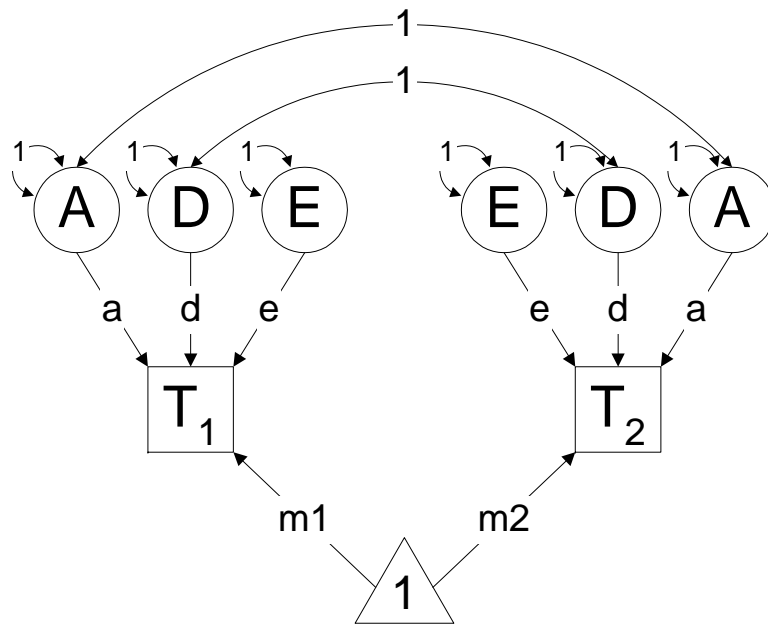
MZ twins



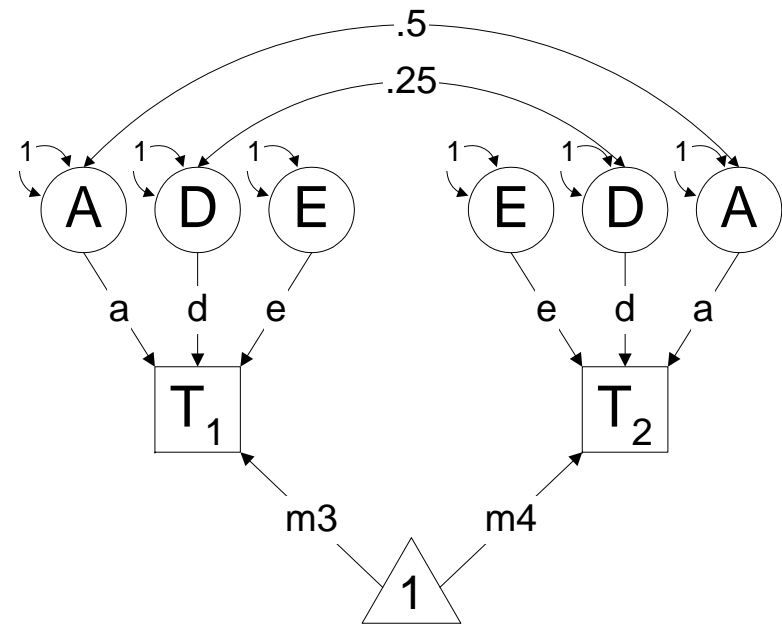
DZ twins

7 parameters: 4 means, 3 path coefficients:  $a$ ,  $c$ ,  $e$

# ADE Model



MZ twins



DZ twins

7 parameters: 4 means, 3 path coefficients: a, d, e



# Tests

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

- #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

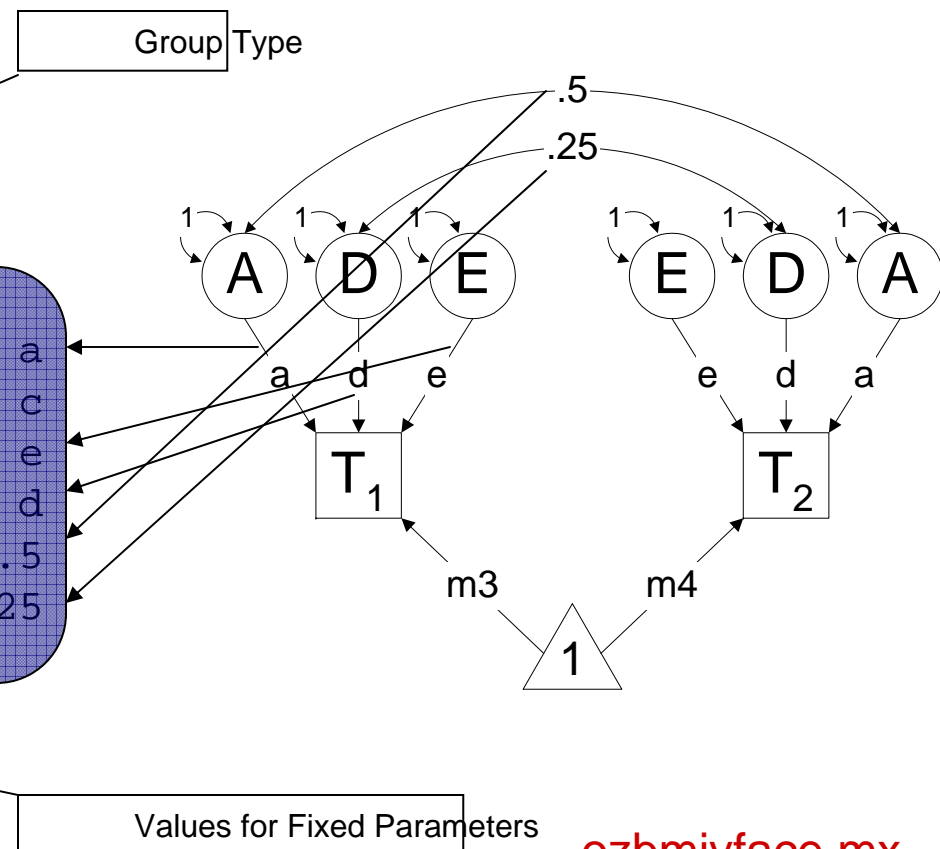
■ H Full 1 1 ! 0.5

■ Q Full 1 1 ! 0.25

■ End Matrices;

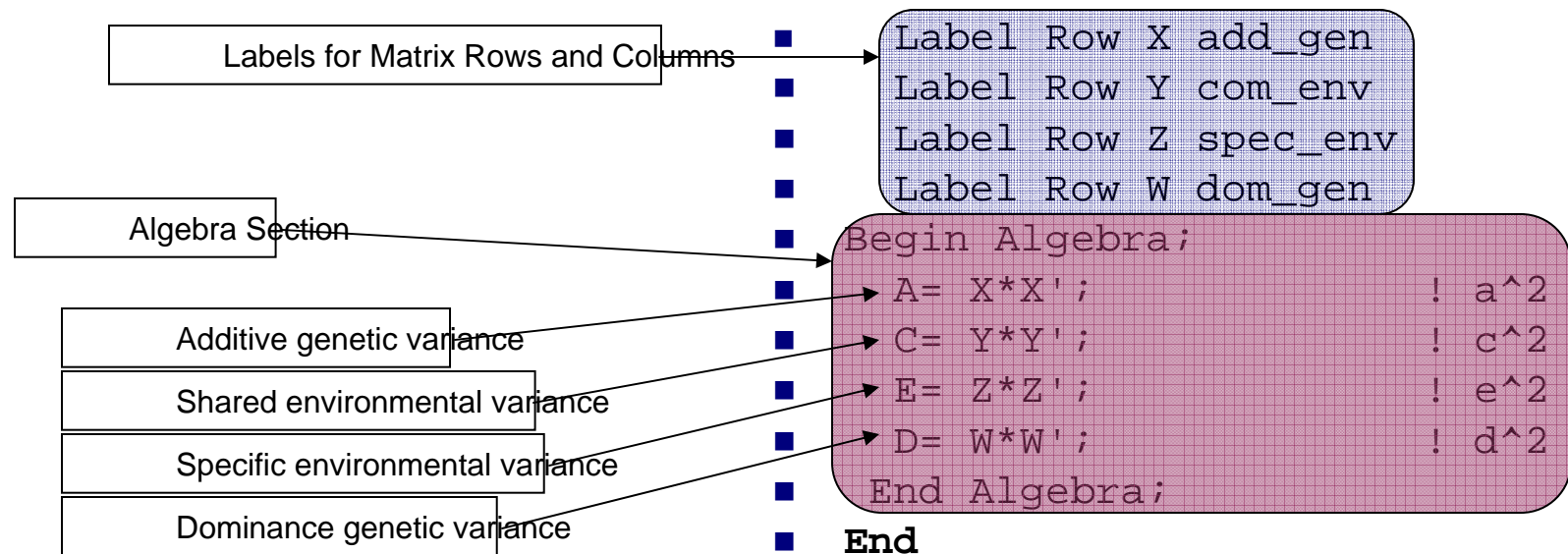
■ Matrix H .5

■ Matrix Q .25



# ! Estimate variance components - ACED model

## ! OZ BMI data - younger females





# ! Estimate variance components - ACED model

## ! OZ BMI data - younger females II

- Title 2: MZ data
- #include ozbmi2.dat
- Select if zyg =1
- Select if agecat =1
- Select bmi1 bmi2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- End Matrices;
- Means M;
- Covariance
- $$\begin{array}{c|c} A+C+E+D & A+C+D \\ \hline A+C+D & A+C+E+D \end{array} ;$$
- Option RSiduals;
- End

- Title 3: DZ data
- #include ozbmi2.dat
- Select if zyg =3
- Select if agecat =1
- Select bmi1 bmi2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- End Matrices;
- Means M;
- Covariance
- $$\begin{array}{c|c} A+C+E+D & H@A+C+Q@D \\ \hline H@A+C+Q@D & A+C+E+D \end{array} ;$$
- Option RSiduals
- End

# ! Estimate variance components - ACED model

## ! OZ BMI data - younger females II

Copy Matrices from Group 1

- Title 2: MZ data
- #include ozbmi2.dat
- Select if zyg =1
- Select if agecat =1
- Select bmi1 bmi2 ;

```
Begin Matrices = Group 1;
  M Full 1 nvar2 Free
End Matrices;
```

```
Means M;
Covariance
  A+C+E+D | A+C+D  _
  A+C+D   | A+C+E+D ;
```

- Option RSiduals;
- End

Model Statements

$$\left[ \begin{array}{c|c} a^2+c^2+e^2+d^2 & a^2+c^2+d^2 \\ \hline a^2+c^2+d^2 & a^2+c^2+e^2+d^2 \end{array} \right]$$

- Title 3: DZ data
- #include ozbmi2.dat
- Select if zyg =3
- Select if agecat =1
- Select bmi1 bmi2 ;

```
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

Kronecker product

$$\left[ \begin{array}{c|c} a^2+c^2+e^2+d^2 & .5a^2+c^2+.25d^2 \\ \hline .5a^2+c^2+.25d^2 & a^2+c^2+e^2+d^2 \end{array} \right]$$



# ! 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

# ! 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
```

Start Values for all free Parameters

Overwrite Start Values for Means

```
Begin Algebra;
```

```
V=A+C+E+D;
```

```
P=A|C|E|D;
```

```
S=P@V~;
```

```
End Algebra;
```

Calculate Total Variance by adding 4 Variance Components

Sticking 4 Variance Components together in 1 Matrix

Multiplying each of 4 Variance Components by the Inverse of the Variance  
Equivalent to Dividing Variance Components by the Variance  
to get Standardized Variance Components

- !ADE model

```
Interval S 1 1 - S 1 4
```

Calculate 95% Confidence Intervals

- Option NDecimals=4

```
Option Sat=4055.935,1767
```

- End

Compare with Likelihood (-2LL, df) of Saturated model (ozbmiyfsat.mx  
to obtain Chi-square Goodness-of-Fit Statistics

# ! 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 2
- Start 20 M 3 1 1 - M 3 1 2
- 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



# ! 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 2
- Start 20 M 3 1 1 - M 3 1 2
- 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

Indicates to Mx that you want to fit submodels which will follow,  
Has to be before the End statement of the Last Group of your Main Script

- Submodel, just requires Changes compared to Full \$
- !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

Drop fixes Parameter 1

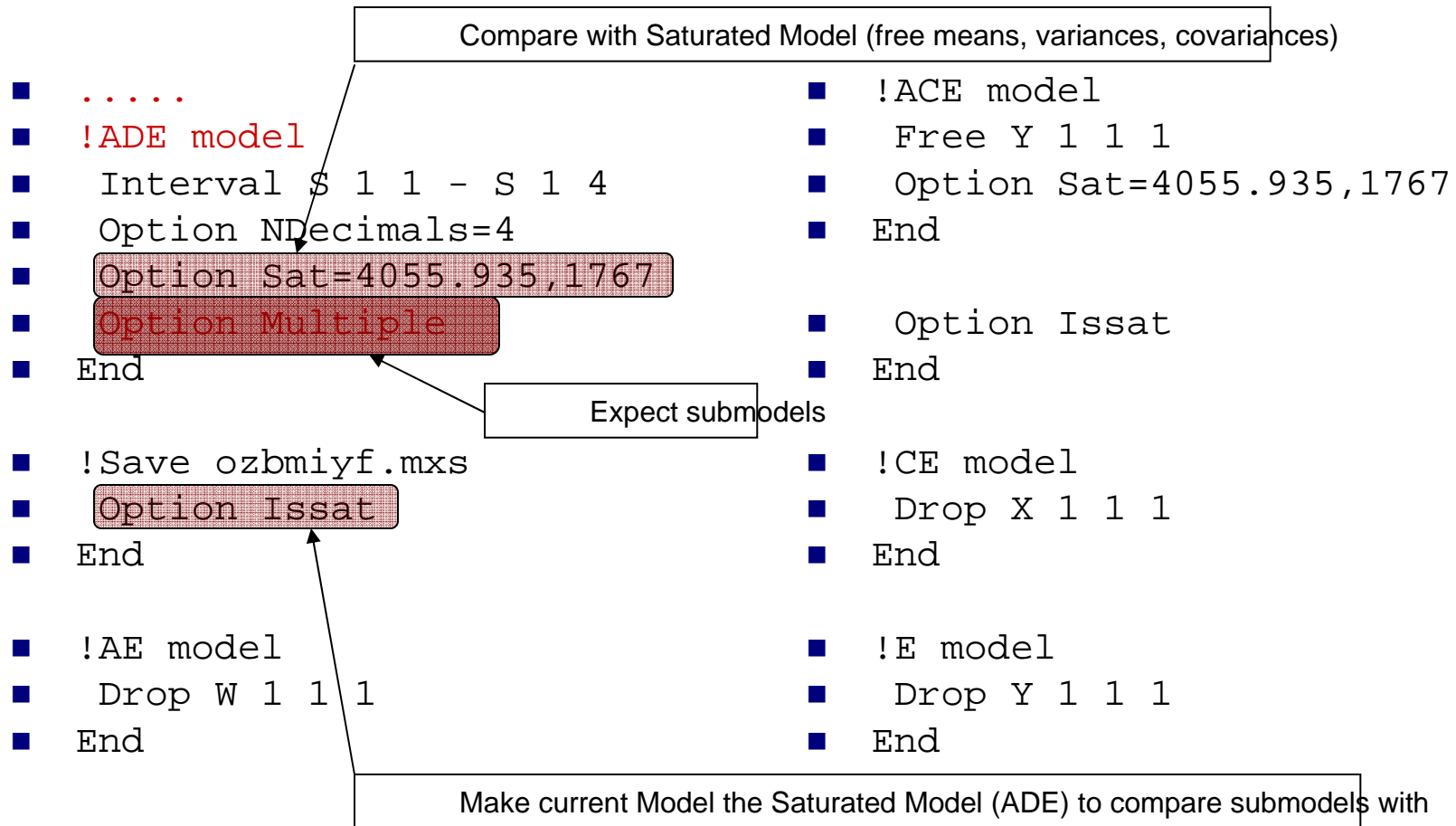
Free previously fixed Param

# 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



ozbmiyfaces2.mx

# Submodels: ozbmifyaces2.mx

Matrix / Model	X (a)	Y (c)	Z (e)	W (d)	Cov NP	Mean NP	NP	Sat NP	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

NP: number of parameters, Sat: saturated, DF: degrees of freedom





# Goodness-of-Fit for BMI yf

	-2LL	df	$R^2$	df	p	AIC	$\chi^2$	df	p
Sat	4055.93	1767					$R^2$		
ADE	4059.21	1770	3.28	3	.35	-2.72			
AE	4063.61	1771	7.68	4	.10	-0.32	4.40	1	.04
ACE	4063.61	1770	7.68	3	.05	1.68			
CE	4216.29	1771	160.	4	.00	152	152	1	.00
E	4585.59	1772	529.	5	.00	519	521	2	.00

# Parameter Estimates for BMI yf

	Path coefficients				Variance comp				Stand var comp			
	a	c	e	d	a <sup>2</sup>	c <sup>2</sup>	e <sup>2</sup>	d <sup>2</sup>	a <sup>2</sup>	c <sup>2</sup>	e <sup>2</sup>	d <sup>2</sup>
Sat												
ADE	.56		.41	.54	.31		.17	.29	.40		.22	.38
AE	.78		.42		.61		.17		.78		.22	
ACE	.78	.00	.42		.61	.00	.17		.78	.00	.22	
CE		.67	.56			.47	.32			.59	.41	
E			.88				.77				1.0	