



Heterogeneity

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Files to Copy to your Computer

- Faculty/hmaes/tc19/maes/heterogeneity
 - ozbmi.rec
 - ozbmi.dat
 - ozbmiysat(4)(5).mx
 - ozbmiyace(4)(eq)(5).mx
 - Heterogeneity.ppt



Heterogeneity Questions

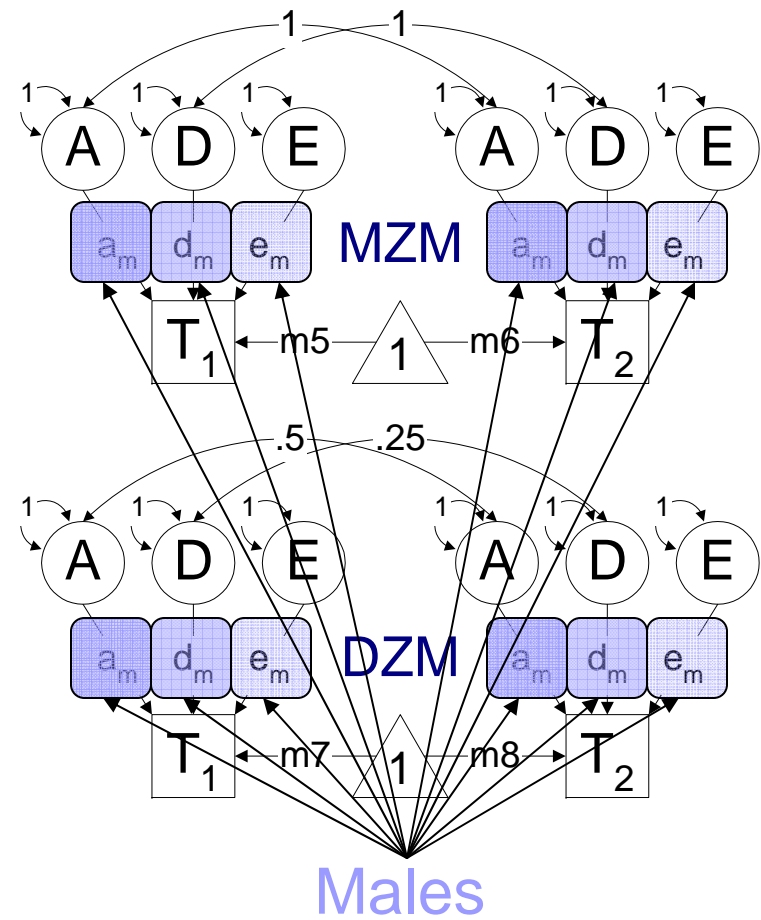
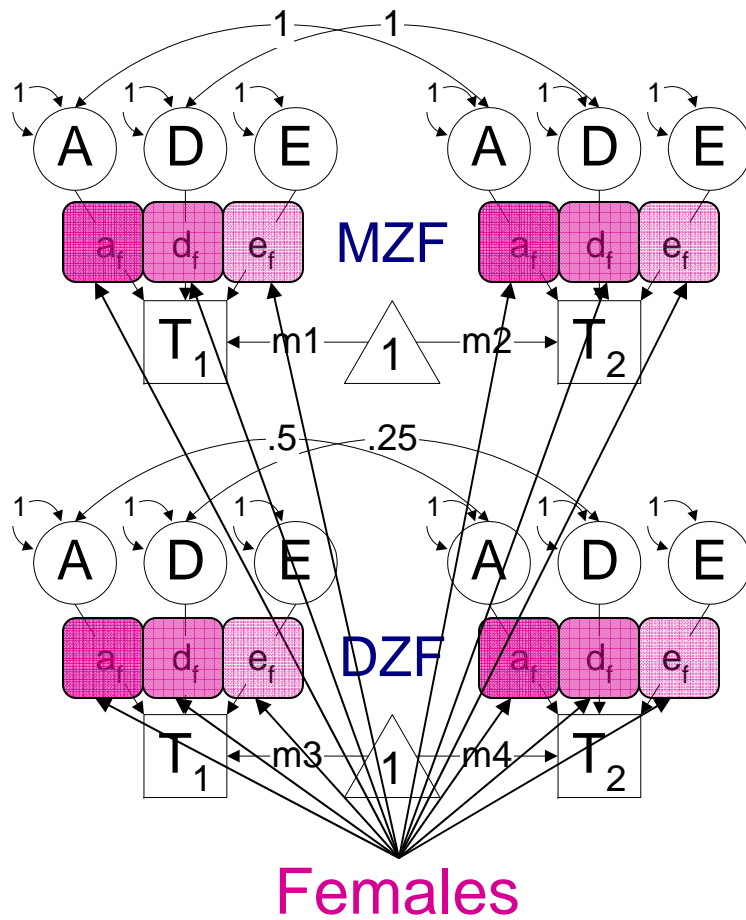
- Are these differences due to differences in the magnitude of the effects (quantitative)?
 - e.g. Is the contribution of genetic/environmental factors greater/smaller in males than in females?
- Are the differences due to differences in the nature of the effects (qualitative)?
 - e.g. Are there different genetic/environmental factors influencing the trait in males and females?



Groups

Comparison	Concordant for group membership	Discordant for group membership
gender	MZ & DZ: MM & FF pairs	DZ: opposite sex pairs
age	MZ & DZ: young & old pairs	
nationality	MZ & DZ: OZ & US pairs	
environment	MZ & DZ: urban & rural pairs	MZ & DZ: urban/ rural pairs

Heterogeneity

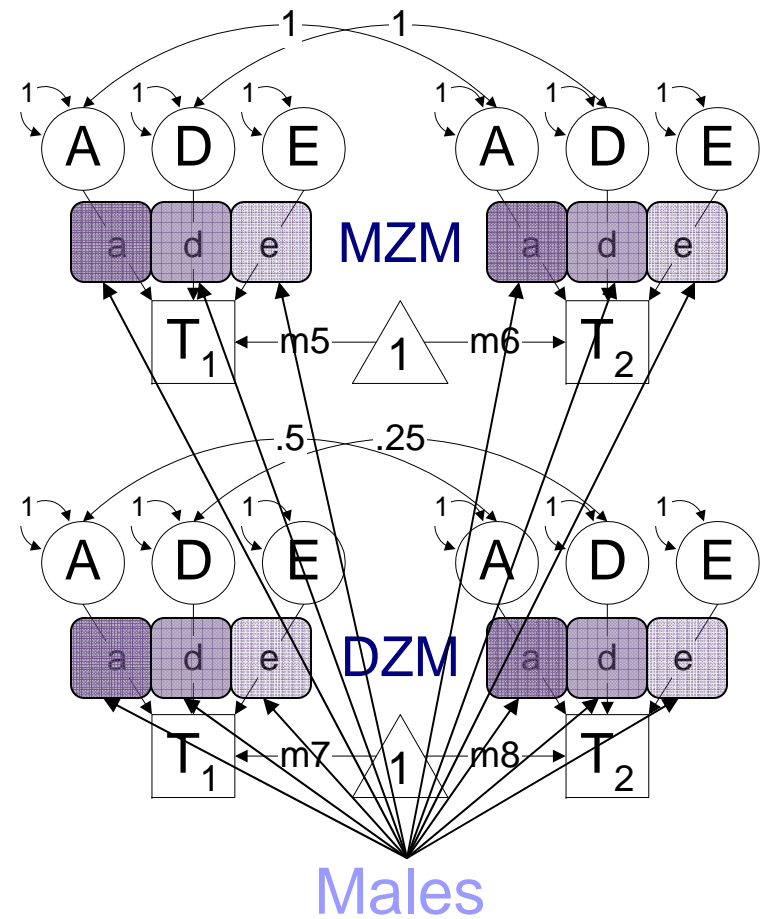
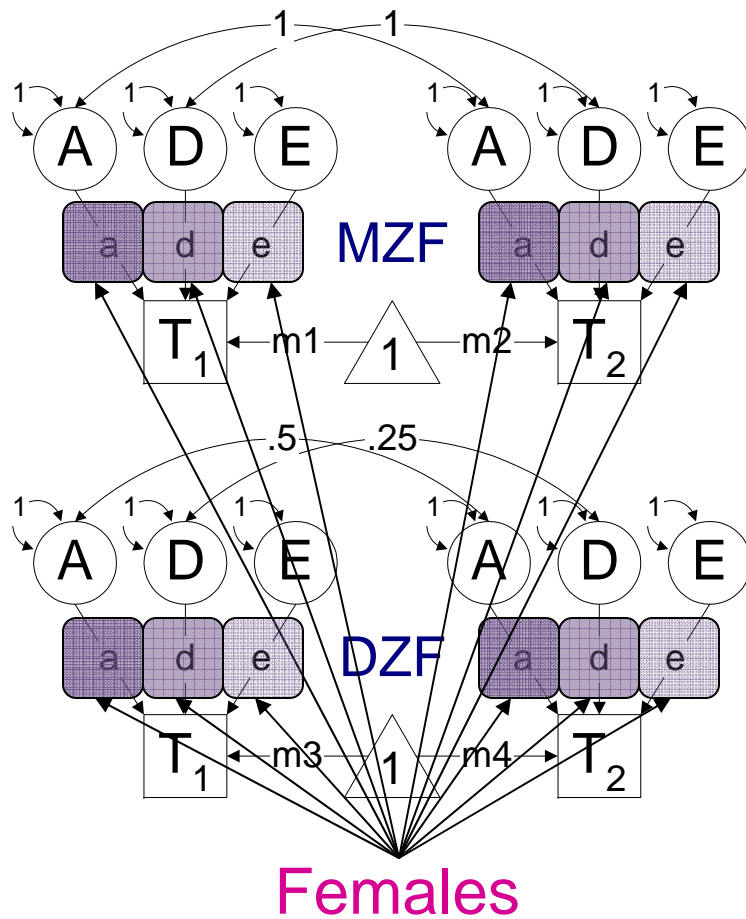


Homogeneity

Equate $a_f = a_m$

Equate $e_f = e_m$

Equate $d_f = d_m$



Goodness-of-Fit Statistics for BMI in young females+males

	-2LL	df	χ^2	df	p	AIC	χ^2	df	p
Sat	4055.93 f 1939.72 m 5995.65	1767 900 2667							
Het	4059.21 f 1947.06 m 6006.27	1770 903 2673	3.28 7.33 10.61	3 3 6	.35 .06 .10	-2.72 1.33 -1.39			
Hom	6014.69	2676	19.03	9	.03	1.03	8.42	3	.04

Parameter Estimates for BMI in young females+males

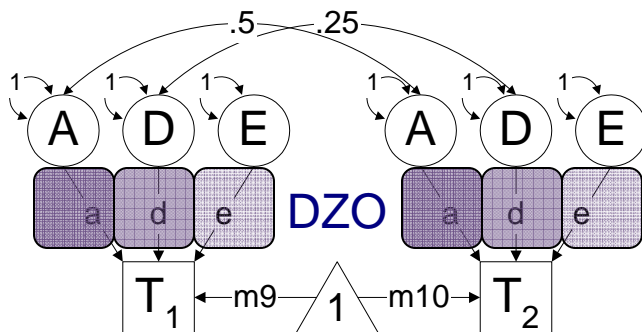
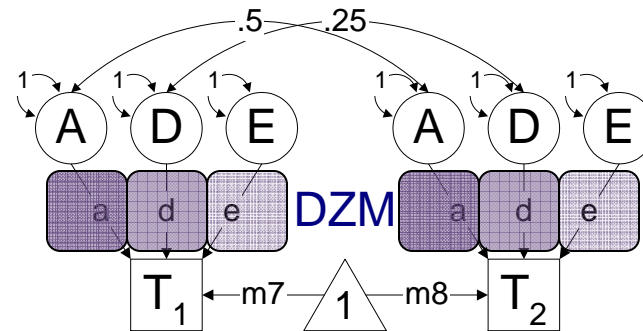
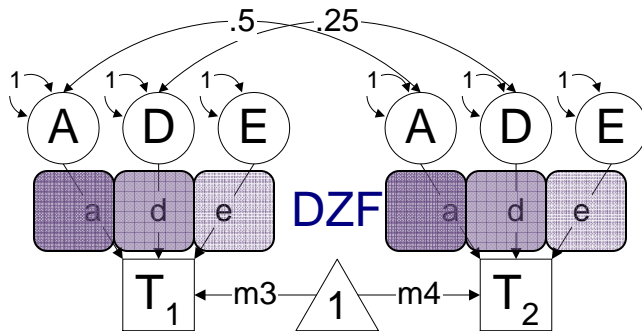
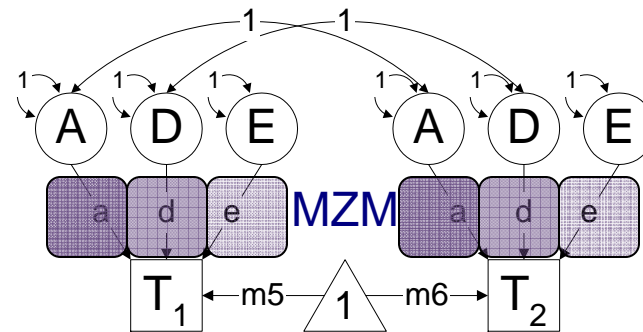
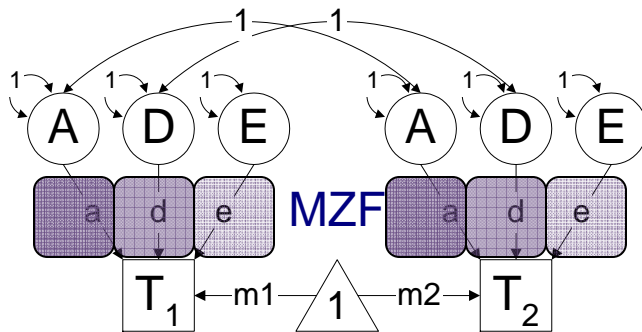
	females						males					
	Paths			Var Comp			Paths			Var Comp		
	a_f	e_f	d_f	a_f^2	e_f^2	d_f^2	a_m	e_m	d_m	a_m^2	e_m^2	d_m^2
Heterogeneity												
ADE	.56	.41	.54	.31	.17	.29	.49	.37	.54	.23	.14	.29
AE	.78	.42		.61	.17		.73	.38		.54	.14	
Homogeneity												
ADE	.54	.40	.54	.29	.16	.29	.54	.40	.54	.29	.16	.29
AE	.77	.40		.59	.16		.77	.40		.59	.16	



What about DZO?

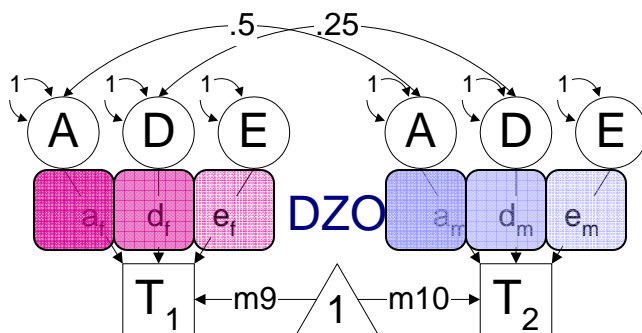
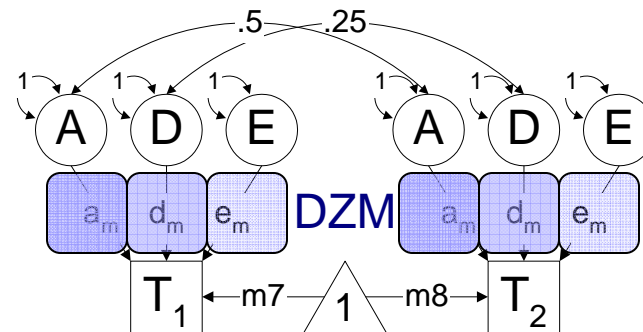
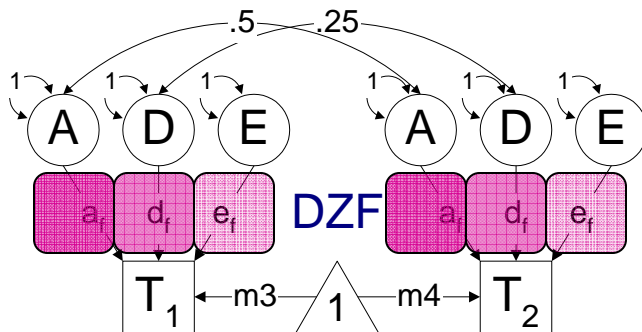
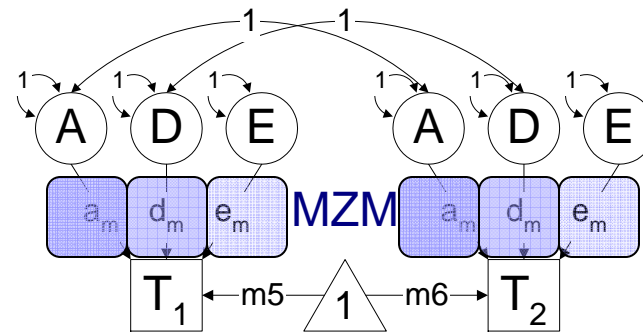
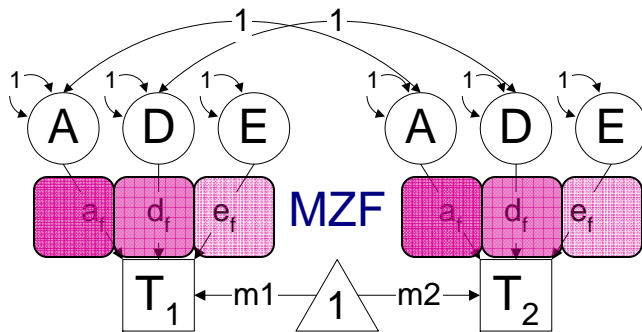
- Var F, Cov MZF, Cov DZF
 - a_f, d_f, e_f
- Var M, Cov MZM, Cov DZM
 - a_m, d_m, e_m
- Var Fdzo = Var F, Var M dzo = Var M
- Cov DZO
 - r_g

Homogeneity



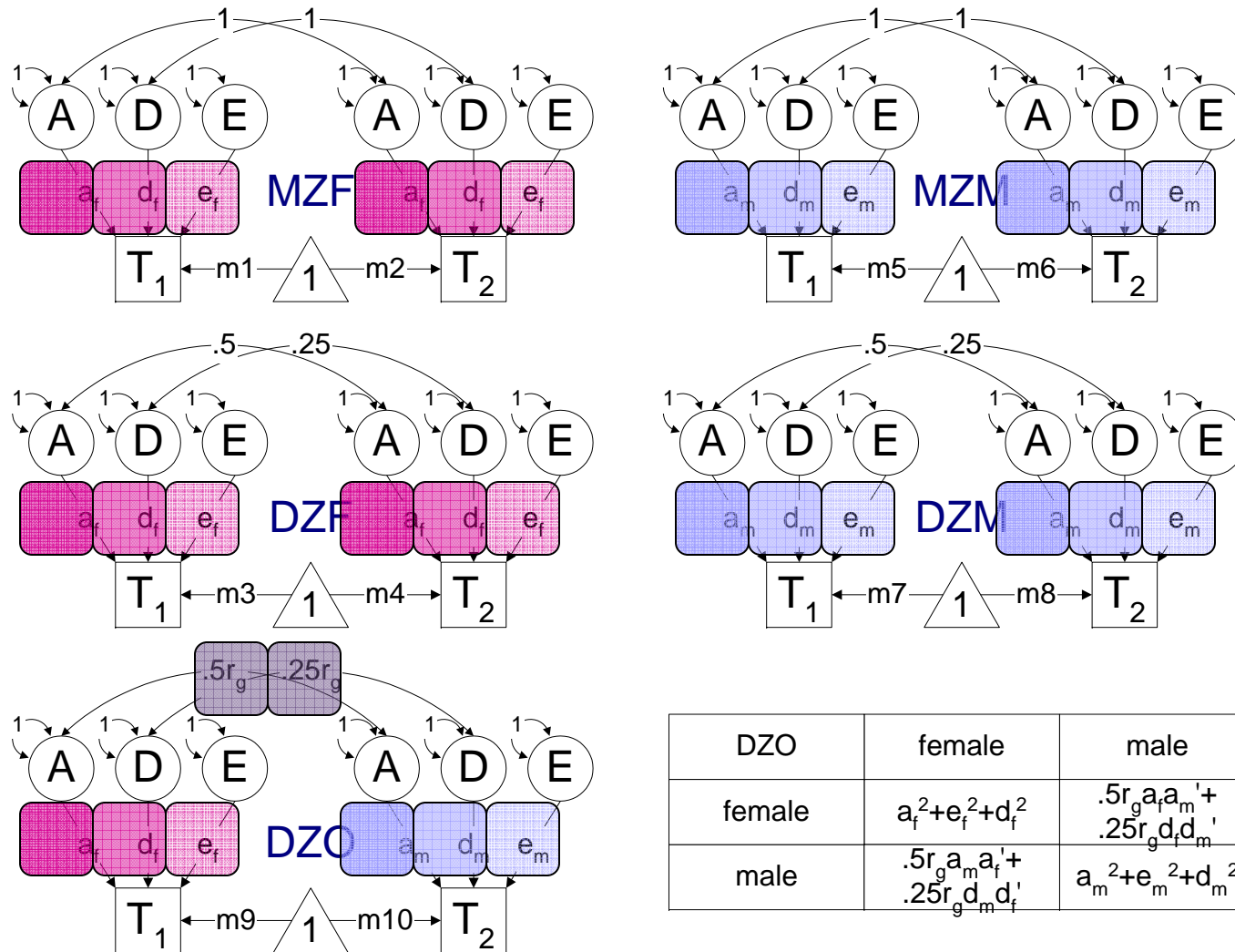
DZO	female	male
female	$a^2+e^2+d^2$	$.5a^2+.25d^2$
male	$.5a^2+.25d^2$	$a^2+e^2+d^2$

Heterogeneity



DZO	female	male
female	$a_f^2 + e_f^2 + d_f^2$	$.5a_f a_m' + .25d_f d_m'$
male	$.5a_m a_f' + .25d_m d_f'$	$a_m^2 + e_m^2 + d_m^2$

General Sex Limitation



DZO	female	male
female	$a_f^2 + e_f^2 + d_f^2$	$.5r_g a_f a_m' + .25r_g d_f d_m'$
male	$.5r_g a_m a_f' + .25r_g d_m d_f'$	$a_m^2 + e_m^2 + d_m^2$

Models for Concordant and Discordant Pairs

	G1 MZ	G1 DZ	G2 MZ	G2 DZ	G1G2 DZ	EP
Saturated	v1 v2 cov m1 m2	v3 v4 cov m3 m4	v5 v6 cov m5 m6	v7 v8 cov m7 m8	v9 v10 cov m9 m10	15 + 10
General	a ₁ d ₁ e ₁ m1 m2	a ₁ d ₁ e ₁ m3 m4	a ₂ d ₂ e ₂ m5 m6	a ₂ d ₂ e ₂ m7 m8	a ₁ d ₁ e ₁ a ₂ c ₂ e ₂ r _g m9 m10	7 + 10
Hetero- geneity	a ₁ d ₁ e ₁ m1 m2	a ₁ d ₁ e ₁ m3 m4	a ₂ d ₂ e ₂ m5 m6	a ₂ d ₂ e ₂ m7 m8	a ₁ d ₁ e ₁ a ₂ c ₂ e ₂ m9 m10	6 + 10
Homo- geneity	a ₁ d ₁ e ₁ m1 m2	a ₁ d ₁ e ₁ m3 m4	a ₁ d ₁ e ₁ m5 m6	a ₁ d ₁ e ₁ m7 m8	a ₁ d ₁ e ₁ m9 m10	3 + 10



Summary of Models

- **General Sex Limitation Model:**
 - quantitative and qualitative differences
- **Heterogeneity Model:**
 - quantitative but no qualitative differences
- **Homogeneity Model:**
 - no quantitative, no qualitative differences

! Estimate variance components - ACED model

! OZ BMI data - young females & males + opp sex

- #NGroups 7
- #define nvar 1
- #define nvar2 2

- G1: Parameters
- Calculation
- Begin Matrices;
- X Lower nvar nvar Free ! FEMALES a
- Y Lower nvar nvar ! FEMALES c
- Z Lower nvar nvar Free ! FEMALES e
- W Lower nvar nvar Free ! FEMALES d
- S Lower nvar nvar Free ! MALES a
- T Lower nvar nvar ! MALES c
- U Lower nvar nvar Free ! MALES e
- V Lower nvar nvar Free ! MALES d
- H Full 1 1 ! scalar, 0.5
- Q Full 1 1 ! scalar, 0.25
- F Full 1 1 Free ! free for DZO
- End Matrices;

Group 1 continued

- Matrix H .5
- Matrix Q .25
- Start 1 F 1 1 1
- Bound 0 1 F 1 1 1
- Begin Algebra;
- A= X*X'; ! FEMALES a^2
- C= Y*Y'; ! FEMALES c^2
- E= Z*Z'; ! FEMALES e^2
- D= W*W'; ! FEMALES d^2
- K= S*S'; ! MALES a^2
- L= T*T'; ! MALES c^2
- N= U*U'; ! MALES e^2
- O= V*V'; ! MALES d^2
- End Algebra;
- End

Groups 2 & 3

- Title G2: MZf 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

- Title G3: DZf 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

Groups 4 & 5

- Title G4: MZm data
- #include ozbmi2.dat
- Select if zyg =2
- Select if agecat =1
- Select bmi1 bmi2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- End Matrices;
- Means M;
- Covariance
- | | | | |
|---------|--|---------|---|
| K+L+N+O | | K+L+O | — |
| K+L+O | | K+L+N+O | ; |
- Option RSiduals;
- End

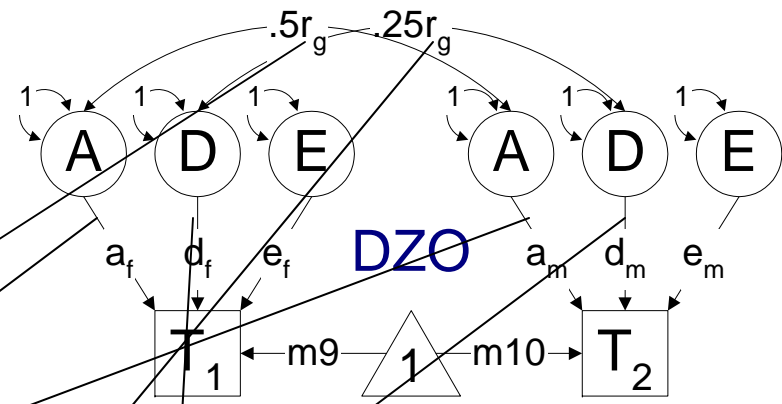
- Title G5: DZm data
- #include ozbmi2.dat
- Select if zyg =4
- Select if agecat =1
- Select bmi1 bmi2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- End Matrices;
- Means M;
- Covariance
- | | | | |
|-----------|--|-----------|---|
| K+L+N+O | | H@K+L+Q@O | — |
| H@K+L+Q@O | | K+L+N+O | ; |
- Option RSiduals
- End

Group 6: DZO

- Title G6: DZfm data
- #include ozbmi2.dat
- Select if zyg =5
- Select if agecat =1
- Select bmi1 bmi2 ;
- Begin Matrices = Group 1;
- M Full 1 nvar2 Free
- End Matrices;
- Means M;
- Covariance
- $A+C+E+D \quad | \quad F@H@(X*S')+(Y*T')+F@Q@(W*V') \quad -$
- $F@H@(S*X')+(T*Y')+F@Q@(V*W') \quad | \quad K+L+N+O \quad ;$
- Option RSiduals
- End

Variance females

Variance males



Group 7

- Title G7: Standardization
- Calculation
- Begin Matrices = Group 1;
- Start .5 all
- Start 20 M 2 1 1 - M 2 1 nvar2
- Start 20 M 3 1 1 - M 3 1 nvar2
- Start 20 M 4 1 1 - M 4 1 nvar2
- Start 20 M 5 1 1 - M 5 1 nvar2
- Start 20 M 6 1 1 - M 6 1 nvar2
- Begin Algebra;
- G= A+C+E+D; ! FEMALES total variance
- J= K+L+N+O; ! MALES total variance
- P= A%G | C%G | E%G | D%G_ ! FEMALES stand variance components
- K%J | L%J | N%J | O%J; ! MALES stand variance components
- End Algebra;
- Option NDecimals=4
- !ADE model
- Option Sat=8310.308, 3633
- Option Multiple
- End

Submodels

- Last Group
- Option Sat=8310.308, 3633
- Option Multiple
- End

- Option Issat
- End

- ! Test for qualitative sex differences (nature of effect)
- `Drop @1 F 1 1 1 ! drop rg`
- End

- Option Issat
- End


- ! Test for quantitative sex differences (magnitude of effect)
- `Equate X 1 1 1 S 1 1 1 ! a_f = a_m`
- `Equate Z 1 1 1 U 1 1 1 ! e_f = e_m`
- `Equate W 1 1 1 V 1 1 1 ! d_f = d_m`
- End



Exercise

- Run Sex Limitation Model on 5 groups
 - `ozbmiyade5.mx`

Goodness-of-Fit Statistics for BMI in young females+males+DZO

-2LL	df	χ^2	df	p	AIC	 χ^2	df	p
Saturated								
8310.31	3633							
General Sex Limitation								
8324.49	3641	14.18	8	.08	-1.82			
Heterogeneity								
8324.88	3642	14.57	9	.10	-3.43	.39	1	.53
Homogeneity								
8335.32	3645	25.01	12	.02	1.01	10.44	3	.02

Parameter Estimates for BMI in young females+males+DZO

	females						males						
	Paths			Var Comp			Paths			Var Comp			
r_g	a_f	e_f	d_f	a_f^2	e_f^2	d_f^2	a_m	e_m	d_m	a_m^2	e_m^2	d_m^2	
General Sex Limitation													
	.87	.53	.41	.55	.28	.17	.30	.47	.37	.54	.22	.14	.29
Heterogeneity													
	1.00	.52	.41	.56	.27	.17	.31	.39	.37	.60	.15	.14	.36
Homogeneity													
	1.00	.47	.40	.58	.22	.16	.33	.47	.40	.58	.22	.16	.33