Analysis of Anthropometric Data for Garment Sizing

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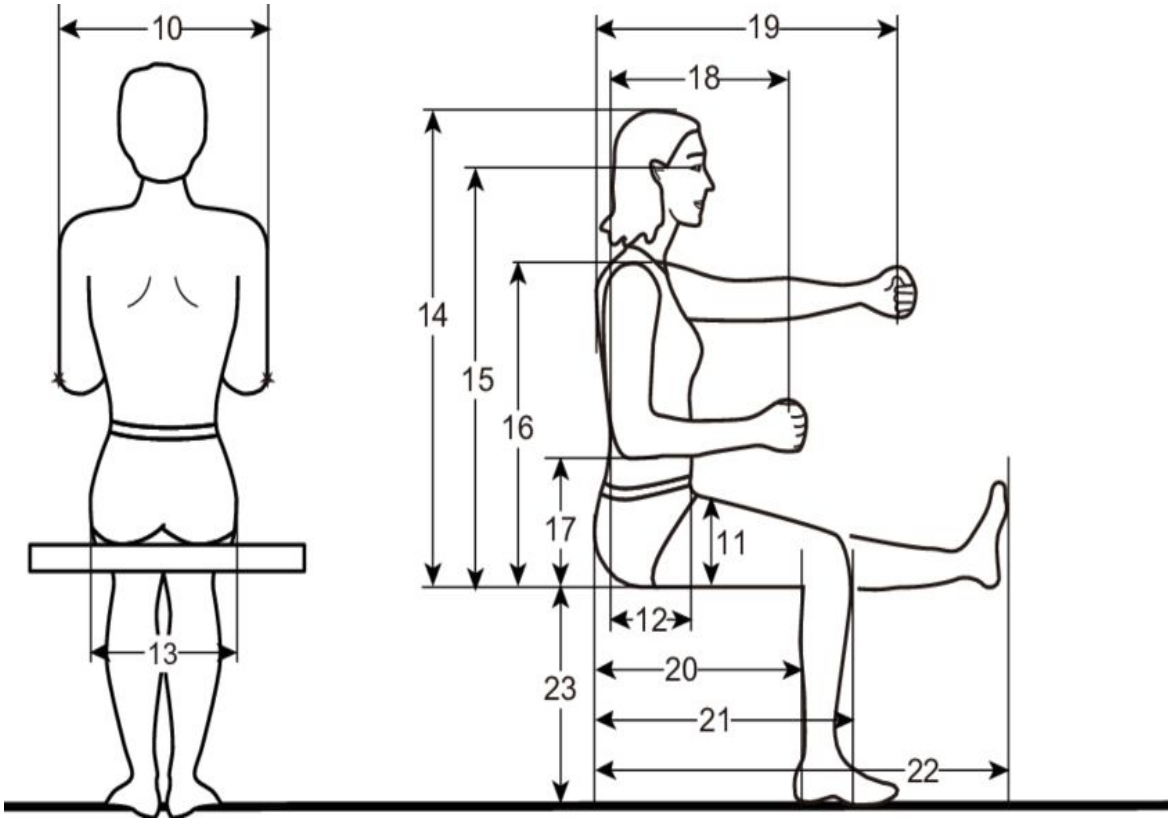
2017MT10755

Anthropometric Data

Anthropos Metron

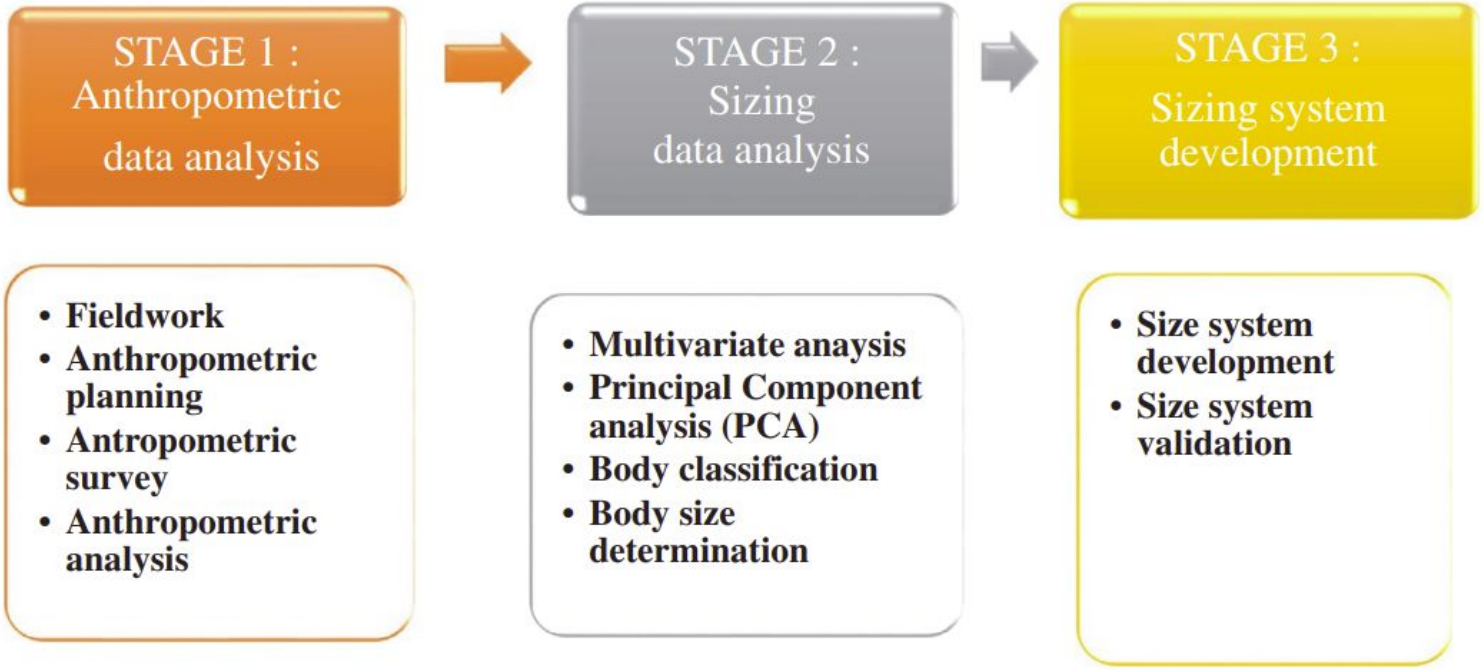
Human Measure



Issues of Garment Industry

How to Proceed

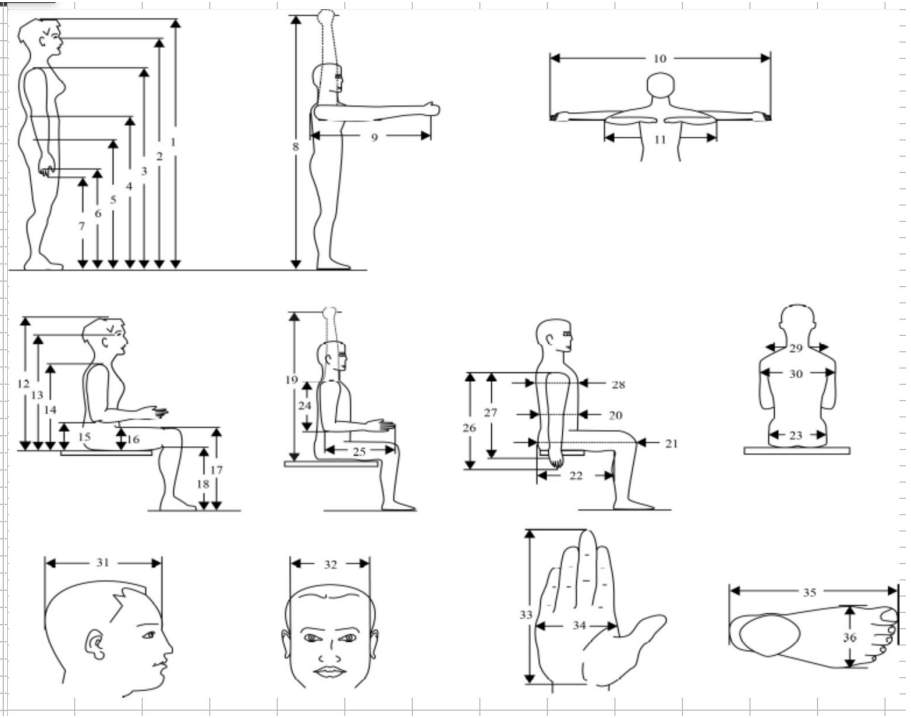
Anthropometric Data → Garment Size



Data Collection and Preprocessing

Which body measurements are required?

	Age	80
	Gender	Male
	Race	Chinese
	Dominant foot	Right
	Dominant hand	Right
Standing Measurements	stature	155.2
	standing eye height	148
	standing shoulder height	127.2
	standing elbow height	98.3
	standing hip height	86.2
	standing knuckle height	68.6
	standing fingertip height	60.2
	standing overhead grip reach	185.3
	forward grip reach	56.8
	span	165.4
	elbow span	95.3
Sitting Measurements	sitting height	84.5
	sitting eye height	77.1
	sitting shoulder height	55.4
	sitting elbow height	24.8
	sitting thigh height	11.8
	sitting knee height	49.1
	sitting popliteal height	40.5
	sitting overhead grip reach	104.4
	abdominal depth	29.6
	buttock knee depth	54.3
	buttock popliteal depth	47.2
	hip breadth	31.8
	shoulder elbow length	31.7
	elbow fingertip length	45.8
	vertical arm length	65.1
	downward grip reach	57.8
	chest depth	19.3
	shoulder breadth biacromial	37.2
	shoulder breadth bideltoid	41.8
	head length	17.2
	head breadth	13.7
	hand length	17.6
	hand breadth	7.9
	foot length	24.2
	foot breadth	9.5



Anthropometry data of Singapore elderly people

Which body measurements are required?

According to ISO Standards

51 body measurement required
- 29 upper body measurement
- 20 lower body measurement

Length (vertical)	Width (vertical)	Girth (horizontal)
Height		Weight
1. [a]Under arm length	1. [a]Shoulder length	1. [a]Head girth
2. [a]Scye depth	2. [a]Shoulder width	2. [a]Neck girth
3. [a]Neck shoulder point to breast point	3. [a]Back width	3. [a]Neck-base girth
4. [a]Cervical to breast point	4. [a]Upper arm length	4. [a]Chest girth
5. [a]Neck shoulder to waist	5. [a]Arm length	5. [a]Bust girth
6. [a]Cervical to waist(front)	6. [a]Seventh cervical to wrist length	6. [a]Upper arm girth
7. [a]Cervical to waist(back)	7. [a]Hand length	7. [a]Armscye girth
8. [a]Cervical height(sitting)	8. Foot length	8. [a]Elbow girth
9. [a]Trunk length		9. [a]Wrist girth
10. [a]Body rise		10. [a]Hand girth
11. [a]Cervical to knee hollow		11. Waist girth
12. [a]Cervical height		12. Hip girth
13. Waist height		13. Thigh girth
14. Outside leg length		14. Mid-thigh girth
15. Waist to hips		15. Knee girth
16. Hip height		16. Lower knee girth
17. Crotch		17. Calf girth
18. Trunk circumference		18. Minimum leg girth
19. Thigh length		19. Ankle girth
20. Inside leg length/crotch		
Height		
21. Knee height		
22. Ankle height		

Lower body dimensions.
[a]Upper body dimensions.

List of body dimensions according to ISO8559/1989

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But This is Exhaustive set !!!

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Do we need all of these??

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2. D. Gupta and B.R. Gangadhar (2004)
   - Bust (for upper) and Hip (for lower) are critical measurements
3. Rachael Granberry, Julia Duvall, Lucy E. Dunne, Bradley Holschuh (2017)
   - six lower leg measurements - ankle, calf, and knee circumferences as well as knee-to ankle, knee to-calf, and ankle-to-calf lengths for lower body

Data Preprocessing

1. Missing Value
   - Continuous Data → Mean (Conventional)

Data Preprocessing

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Data Preprocessing

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1. Missing Value
   - Continuous Data → Mean (Conventional)
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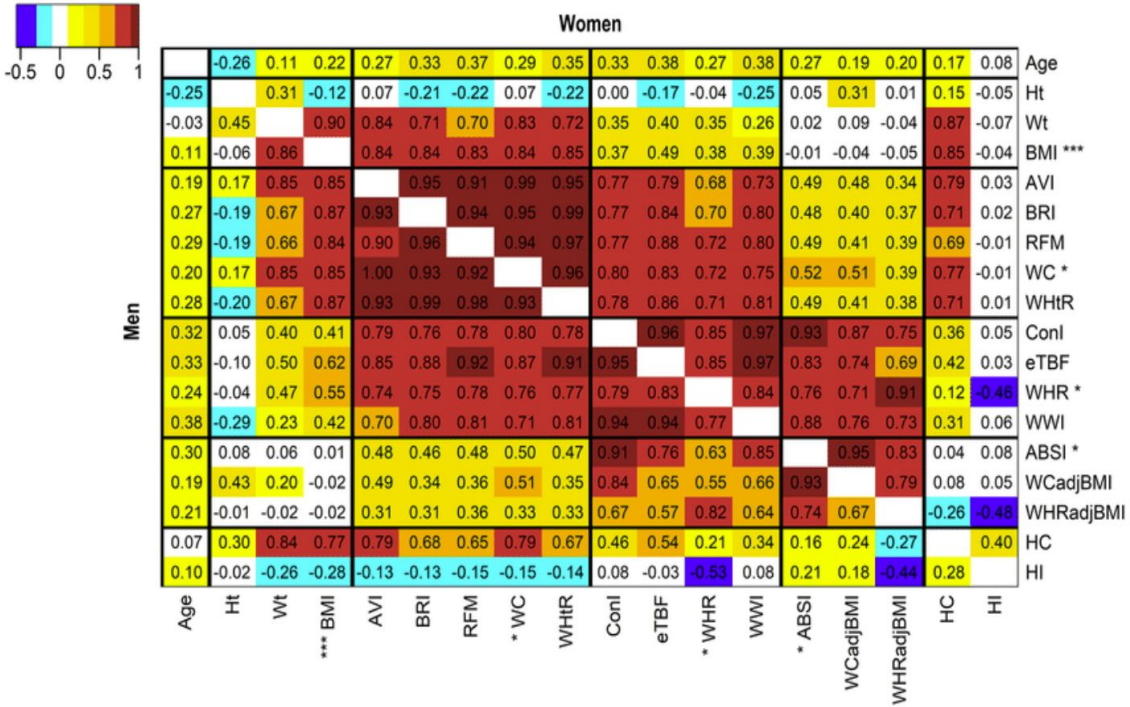
2. Categorical Data
   - Label encoding

Data Analysis

Data Concentration

1. Correlation Matrix Analysis



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1. **Correlation Matrix Analysis**

- Measure of similarity among all features (measurement)
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What to do with similar measurements?

- Keep one column from a set of mutually similar column set having high variance
- According to D. Gupta and B.R. Gangadhar (2004) :
  - Girth and length measures have good correlation among themselves but poor b/w each other
  - Bust, heap, waist and height have been concluded as key measurements

Data Concentration

2. Principal Components Analysis (PCA)

- Dimensionality reduction technique
- Each principal components contain info in decreasing order (1st max..Last min)
- According to D. Gupta and B.R. Gangadhar (2004) :
    - Height should be used as first level of classification followed by Girth (Hip and Bust)

Data Concentration

2. Principal Components Analysis (PCA)

Dimension	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Height	0.02	0.20	0.01	0.01	0
Cervical height	0.03	*0.19*	0.01	0.008	0.00
Natural waist	*0.09*	0.03	0.00	7×10^{-6}	0.018
Waist length_center front	0.02	0.01	*0.29*	0.01	0.01
Cervical _natural waist	0.03	0.01	*0.26*	0.00	0.02
Center back_natural waist	0.01	0.02	*0.23*	0.02	0.03
Artificial waist	*0.09*	0.02	0.00	0.00	0.03
Outer leg	0.02	*0.19*	0.03	0.05	0.00
Inner leg	0.01	*0.12*	0.05	*0.23*	0.01
Hip 4	*0.10*	0.02	0.01	0.00	0.05
Hip 6	*0.10*	0.01	0.02	0.00	0.04
Thigh	0.06	0.01	0.01	0.00	0.01
Knee	0.06	0.00	0.01	0.00	0.00
Ankle	0.02	0.00	0.00	0.01	*0.14*
Bust	*0.09*	0.02	0.00	0.00	0.01
Upper arm girth	0.05	0.01	0.00	0.01	0.04
Wrist	0.02	1×10^{-5}	9×10^{-5}	0.02	*0.31*
Neck_mid	0.08	0.01	0.01	0	0.06
Neck_neck	0.05	0.01	0.01	5×10^{-5}	*0.18*
Arm length	0.01	0.10	0.01	0.00	0.01
Shoulder_shoulder	0.03	0.005	0.0443	0.0062	0.02
Outer leg –inner leg	4×10^{-5}	0.00	0.01	*0.61*	0.01

PCA result by *D. Gupta and B.R. Gangadhar (2004)*

Sizing Analysis

How many different size-category?

- Clustering Technique can be used to determine category
- K-means performs better than Gaussian Mixture Model due to small dataset

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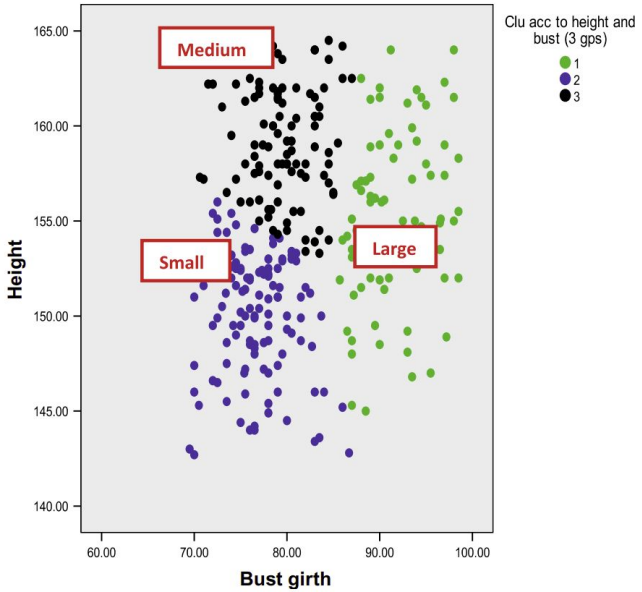
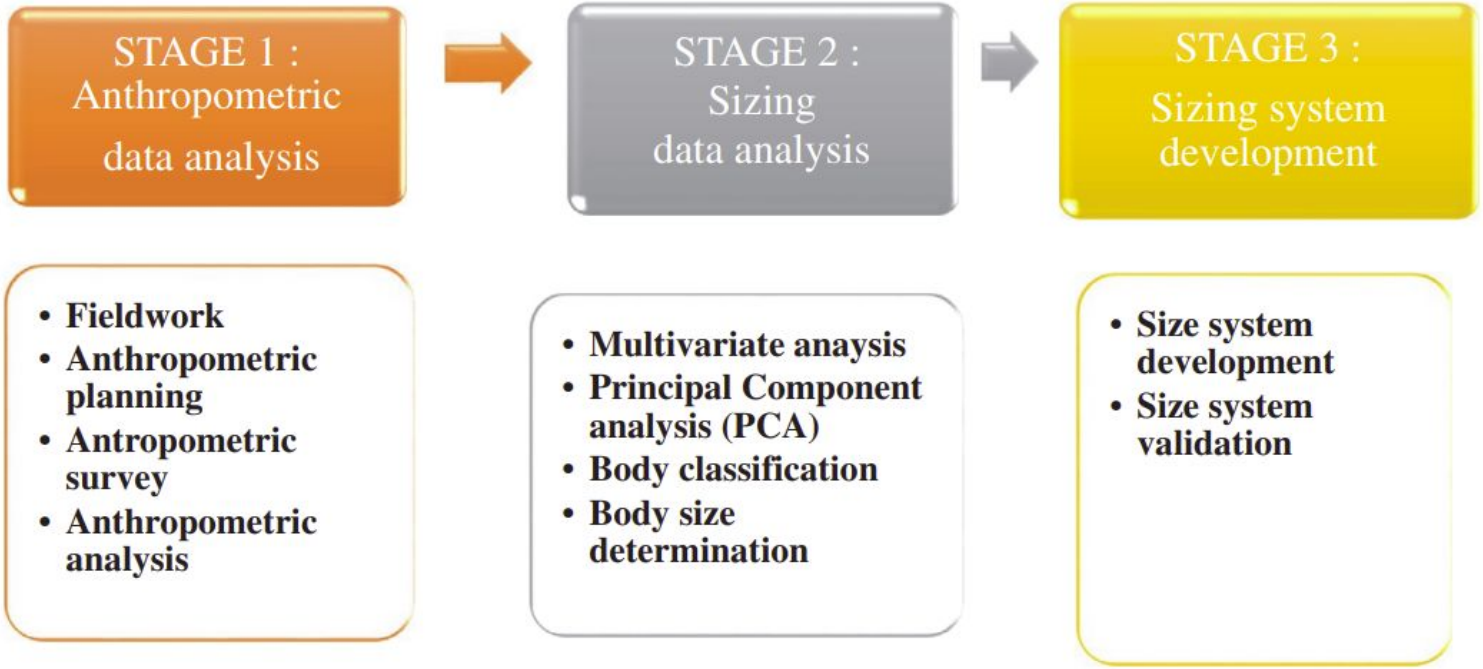
- K-means performs better than Gaussian Mixture Model due to small dataset
- According to Norsaadah Zakariaa, Wan Syazehan Ruznanc (2020) :
  - K=3 and K=4 was found to be most ideal clusters
- Random or Grid search can be used to find K



Final Sizing

- Decision tree or Random forest can be used to finally categorize data into given categories
- Putting constraints on SD may give better fit in each category
- According to a paper by (Chih-Hung Hsu · Mao-Jiun J. Wang, 2004):
  - allow for a wider coverage of body shapes with a fewer number of sizes
  - generate regular sizing patterns and rules

Conclusion


STAGE 1 : Anthropometric data analysis
STAGE 2 : Sizing data analysis
STAGE 3 : Sizing system development
• Fieldwork
• Anthropometric planning
• Antropometric survey
• Anthropometric analysis
• Multivariate anaysis
• Principal Component analysis (PCA)
• Body classification
• Body size determination
• Size system development
• Size system validation

References

1. Norsaadah Zakariaa,b , Wan Syazehan Ruznanc (2020), “Developing apparel sizing system using anthropometric data: Body size and shape analysis, key dimensions, and data segmentation”

2. D. Gupta and B.R. Gangadhar (2004), “A statistical model for developing body size charts for garments”, Indian Institute of Delhi

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4. Rachael Granberry, Julia Duvall, Lucy E. Dunne, Bradley Holschuh (2017), “An Analysis of Anthropometric Geometric Variability of the Lower Leg for the Fit & Function of Advanced Functional Garments”, University of Minnesota

5. Chih-Hung Hsu · Mao-Jiun J. Wang, (2004)

Thankyou