



Skelet-o-matic

.xlsm template for skeletal inventory and automatic homunculi production

CN Stephan, 2016

Skelet-o-matic draws on modified homunculi from the former JPAC-CIL 3401 Forms and Buikstra and Ubelaker (1994)
Standards: For Data Collection from Human Skeletal Remains.

A Macro-Enabled Inventory
Application

Disclosure

The presenter has no trade or commercial interests to disclose.

The software discussed in this presentation is written as freely available open source software (it may require commercial products to run, but the macro itself is free and written for a commonly used platform).

The author does not hold any commercial interests with any of the commercially available software or hardware discussed.

Some comments on Standardization

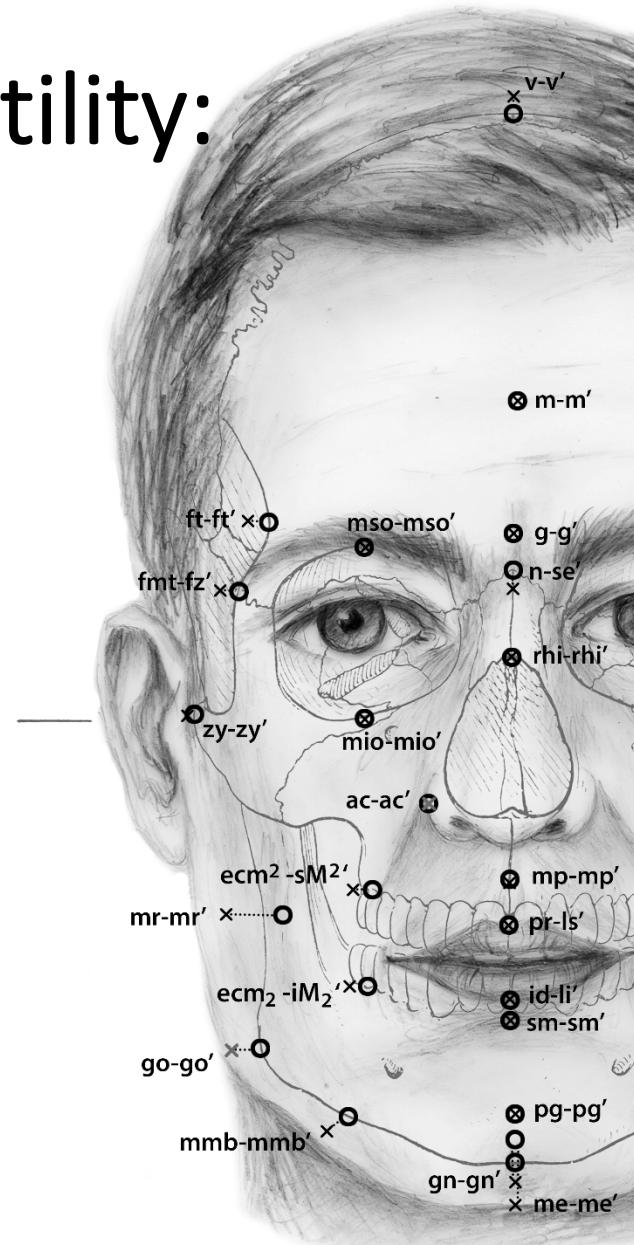
- Official standards (ISO) or recommendations (Discipline)?
- Codification of:
 - End product of a natural evolution to best practice
 - Consensus view (Who's view? Field? Working Party?
Over what time frame?)
 - Unilateral enforcement
- To be successful standardization must hold more value than uniformity alone.
- How narrowly should things be standardized? Most applications are complex in nature and some contexts may not be anticipated.

Unambiguous examples of utility:

Differentiating hard tissue (osteometric) landmarks from soft tissue landmarks:

e.g., glabella (skull) versus glabella (face)
both commonly described by the
abbreviation 'g'.

Solution: Consistently use a prime for the soft tissue, but not for the hard tissue.
i.e., $g-g'$ = linear measurement from hard tissue g to soft tissue g' .



Planning & Objectives

- What is this tool going to deliver?
- Will it truly be helpful for casework / research?
- Does the tool have generic value or is its utility more (i.e., to my problem only)?
- Does it differ to what is already available? Is it worth writing something new?

What digital inventory tools are already out there?

- **Osteoware**

Smithsonian Product

Project Team: Kathleen Adia, Tyler Cargill, Chris Dudar, Joseph T. Hefner, Erica Jones, Marilyn London, Gwyn Madden, Dawn Mulhern, Claire O'Brien, Steve Ousley, Cynthia Wilczak

<https://osteoware.si.edu/>

The image shows the Smithsonian National Museum of Natural History OSTEOWARE website and a screenshot of the Bone Inventory Data Entry software.

OSTEOWARE Website:

- Header: Smithsonian National Museum of Natural History
- Navigation: Plan Your Visit, Exhibitions, Education, Research & Collections, About Us, Get Involved, Calendar
- Main Content: OSTEOWARE, STANDARDIZED SKELETAL DOCUMENTATION
- Left Sidebar: Osteoware Features, Installing & Using Osteoware, Software Downloads, Contact the Project Team
- Right Sidebar: Osteoware Home, Learning to Use Osteoware, The Inventory Module, The Osteoware Inventory Module is composed of four data entry panels: Cranium, Axial Skeleton, Appendicular Skeleton, and Hands and Feet. Nearly all bones in the listed bone have an associated blank/empty box when a record is open.

Bone Inventory Data Entry Software:

- Title: Bone Inventory Data Entry 2.42
- Panel: Z333445
- Sections: Cranium, Axial Skeleton, Appendicular Skeleton, Hands and Feet
- Form Fields:
 - Cranium:** Frontal, Temporal, TMJ, Parietal, Occipital, Sphenoid, Zygomatic, Maxilla, Mandible, Hyoid.
 - Axial Skeleton:** Single, Sternum, Manubrium, Body, Xiphoid.
 - Appendicular Skeleton:** Shoulder, L, R, Clavicle, Scapula, Glenoid.
 - Hands and Feet:** L, R.
- Checkboxes:
 - Commingle
 - Postcranial Nonmetric Traits
 - Lateral Atlas bridge
 - Post Atlas bridge
 - Accessory transverse foramen (C3-C7)
 - Septal aperture
- Legend:
 - Teeth: L horn, Body, R horn
 - Required
 - 1 = Complete; cortex intact (At least 75% of the bone is present)
 - 2 = Partial or Damaged (25 - 75% of the bone is present)
 - 3 = Fragmentary or badly eroded (less than 25% is present)
 - BLANK = Missing

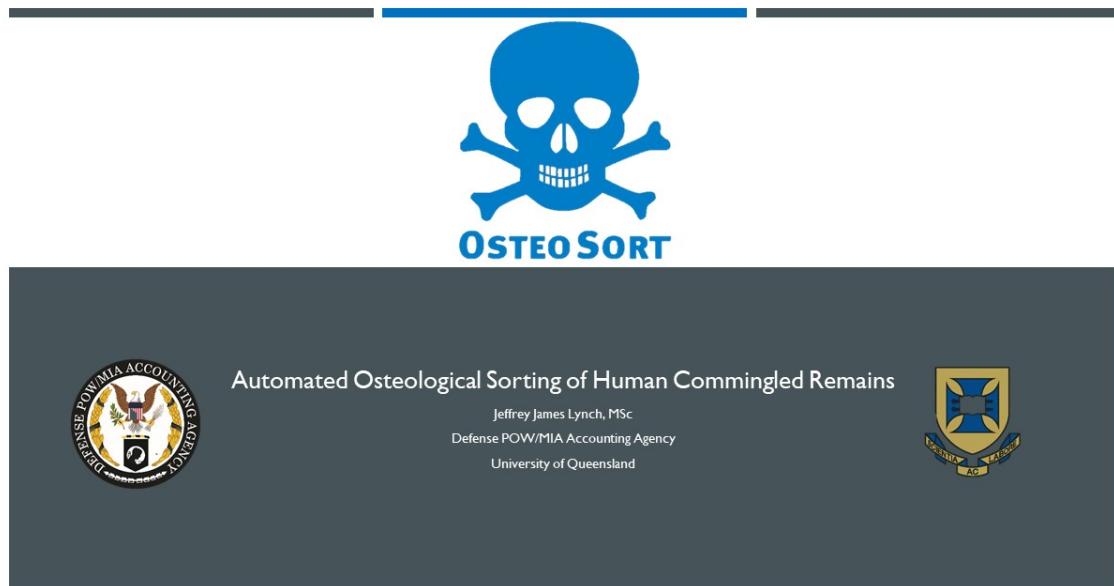
What digital inventory tools are already out there?

- OsteoSort

DPAA

Jeff Lynch

[https://github.com
/jjlynch2/OsteoSort](https://github.com/jjlynch2/OsteoSort)



Inventory is more than numbers...

- Visualisation is important
 - > Akin to Exploratory data analysis. Human brain is not well attuned (at least for most folks) to reading data tables.
- Homunculus provides a visual overview
(details are not the objective, gestalt is)

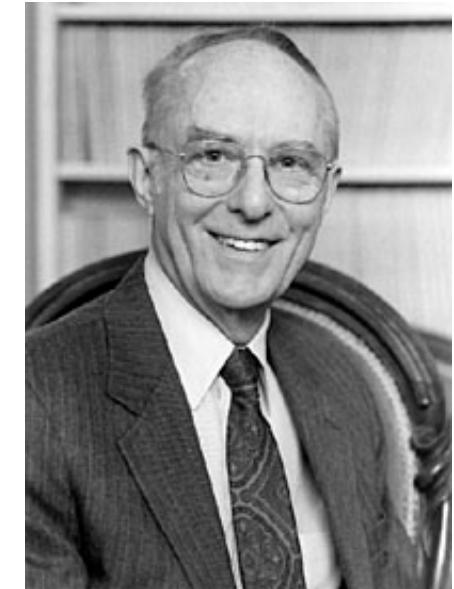
Anscombe's (1973) quartet:

	Dataset 1		Dataset 2		Dataset 3		Dataset 4	
	x1	y1	x1	y2	x3	y3	x4	y4
1	10	8.04	10	9.14	10	7.46	8	6.58
2	8	6.95	8	8.14	8	6.77	8	5.76
3	13	7.58	13	8.74	13	12.74	8	7.71
4	9	8.81	9	8.77	9	7.11	8	8.84
5	11	8.33	11	9.26	11	7.81	8	8.47
6	14	9.96	14	8.1	14	8.84	8	7.04
7	6	7.24	6	6.13	6	6.08	8	5.25
8	4	4.26	4	3.1	4	5.39	19	12.5
9	12	10.84	12	9.13	12	8.15	8	5.56
10	7	4.82	7	7.26	7	6.42	8	7.91
11	5	5.68	5	4.74	5	5.73	8	6.89

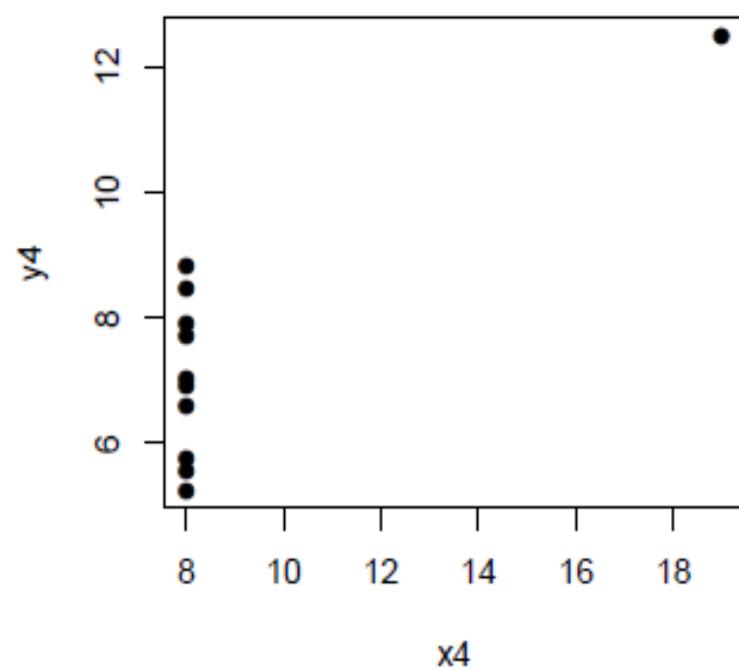
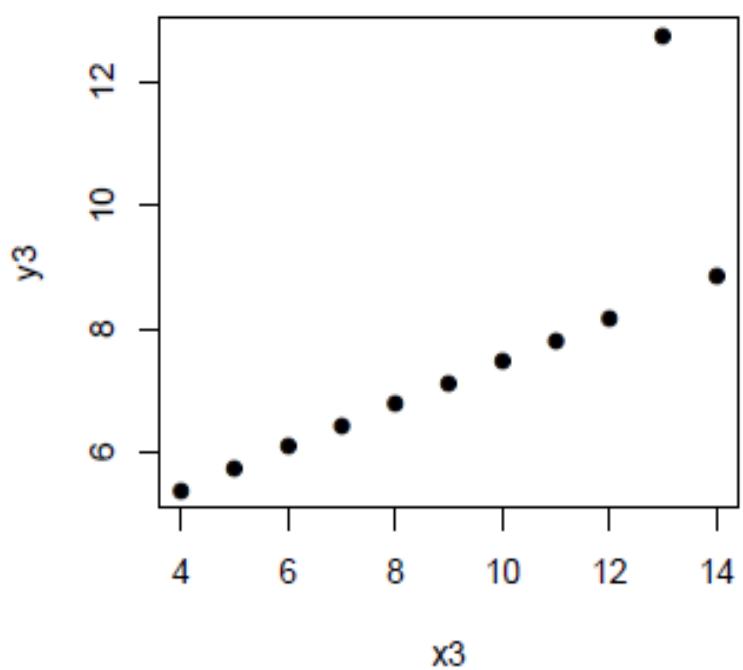
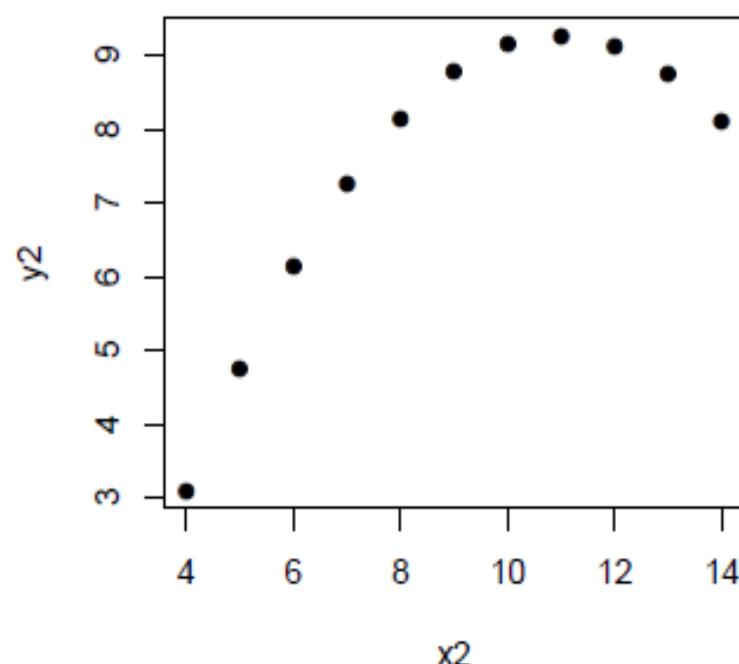
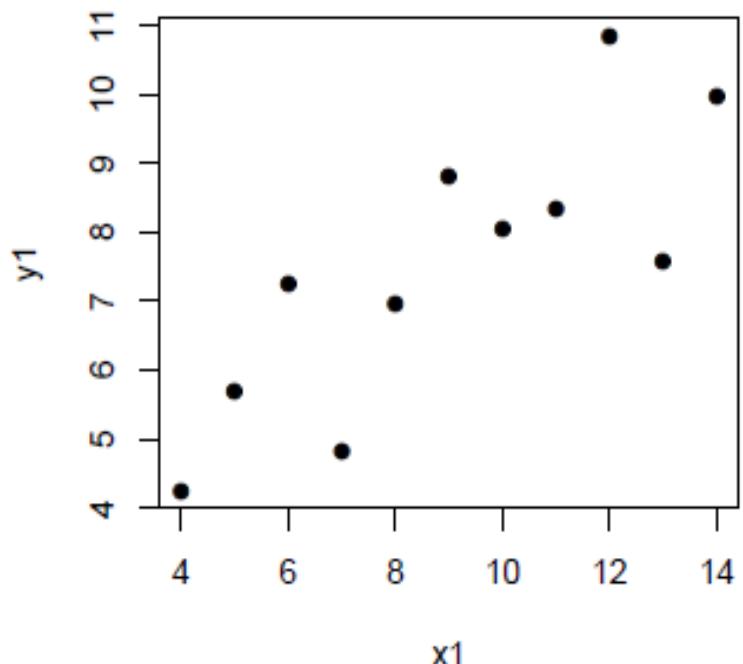


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7	6	7.24	6	6.13	6	6.08	8	5.25
8	4	4.26	4	3.1	4	5.39	19	12.5
9	12	10.84	12	9.13	12	8.15	8	5.56
10	7	4.82	7	7.26	7	6.42	8	7.91
11	5	5.68	5	4.74	5	5.73	8	6.89
Mean	9.00	7.50	9.00	7.50	9.00	7.50	9.00	7.50
SD	3.32	2.03	3.32	2.03	3.32	2.03	3.32	2.03
Variance	11.00	4.13	11.00	4.13	11.00	4.12	11.00	4.12
Correlation		0.82		0.82		0.82		0.82



en.wikipedia.org/wiki/Francis_Anscombe



General Aims of Skelet-o-matic

- Provide user friendly digital inventory checklist
- Auto-generate a skeletal homunculus
- save data in .csv format
(to retrieve as aggregate in R automatically)
- Use of a common (familiar) platform
- Ability to code incomplete elements*

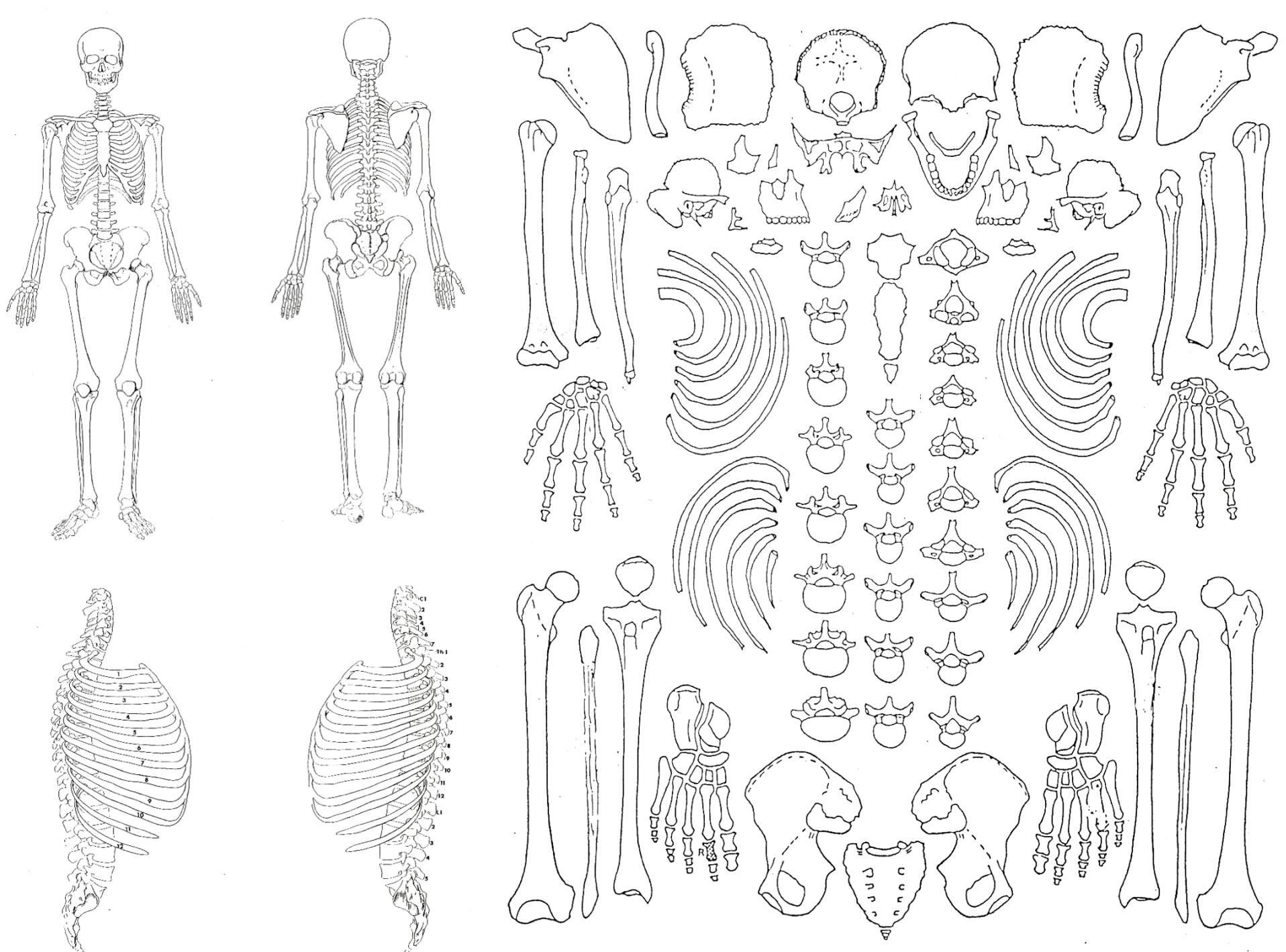
Nuts-&-bolts objectives:

What is the purpose of the Skeletal Homunculus?

- Document everything?
- Document only major elements?
- Precisely document fragmentary elements?

Problems of non-standardisation from the onset:

- There are not 206 bones in the human body....
- There are multiple skeletal homunculi (which to use?)
- Most homunculi do not document all the individual bones.
- What views are important to use?



File Home Insert Page Layout Formulas Data Review View ACROBAT Tell me what you want to do...

Normal Page Break Preview Page Layout Custom Views Ruler Gridlines Formula Bar Headings Zoom 100% Zoom to Selection Window All Freeze Panes Hide Synchronous Scrolling Reset Window Position Split View Side by Side Switch Windows Macros Macros

A2 [e.g., deviated nasal septum; broken left clavicle; amputated distal row phalanx of right 2nd digit; sacralization of lumbar vertebrae; bifid right 4th rib etc.]

1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O											

Skelet-o-matic

C/O HuCS-ID Lab, JPAC-CIL Forms 3401; and
Buikstra and Ubelaker Standards (1994).

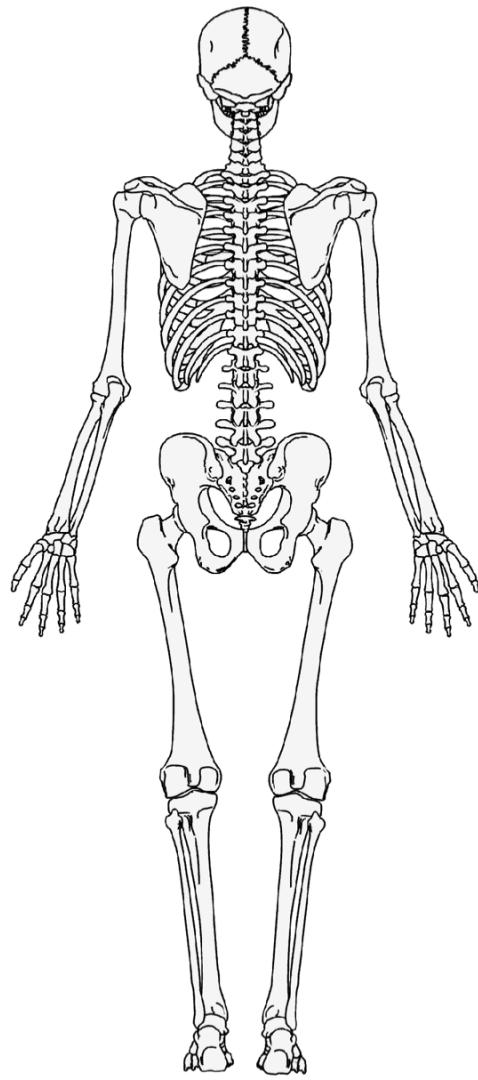
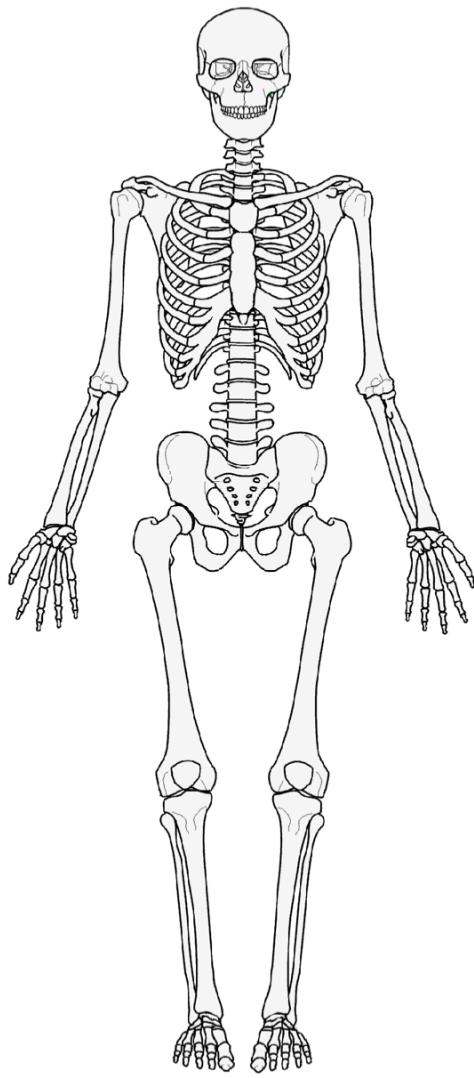
Form XXXX Skeletal Inventory, Single Individual

Last Revised: 10 Aug 2017
Version: 2017.0
User Liscence: GPLv2

Unusual Features: Total # Elements Present = 0 / 254
[e.g., deviated nasal septum; broken left clavicle; amputated distal row phalanx of right 2nd digit; sacralization of lumbar vertebrae; bifid right 4th rib etc.]

Reset Form	Auto Select:	Head				# Elements = 0 / 22									
		C	I	F	Pres.	C	I	F	Pres.	C	I	F	Pres.		
Skull (auto select)	<input type="checkbox"/>				FALSE	Temporal - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Palatine - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Cranium (auto select)	<input type="checkbox"/>				FALSE	Temporal - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Palantine - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Neurocranium (auto select)	<input type="checkbox"/>				FALSE	Occipital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Nasal - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Splanchnocranum (auto select)	<input type="checkbox"/>				FALSE	Sphenoid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Nasal - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
						Ethmoid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Lacrimal - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Mandible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		FALSE	Zygomatic - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Lacrimal - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Frontal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		FALSE	Zygomatic - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Vomer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Parietal - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		FALSE	Maxillary - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Inf. Nasal Concha - L	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE
Parietal - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		FALSE	Maxillary - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE	Inf. Nasal Concha - R	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FALSE

Dental				# Elements = 0 / 32			
C	I	F	Pres.	C	I	F	Pres.



- Absent
- Complete (>95%)
- Incomplete (25% <x<94%)
- Fragmentary (<24%)

Osteoware:

1=Complete; cortex intact (at least 75% of the bone is present)

2=Partial or Damaged (25 - 75% of the bone is present)

3=Fragmentary or badly eroded (less than 25% is present)

BLANK=Missing

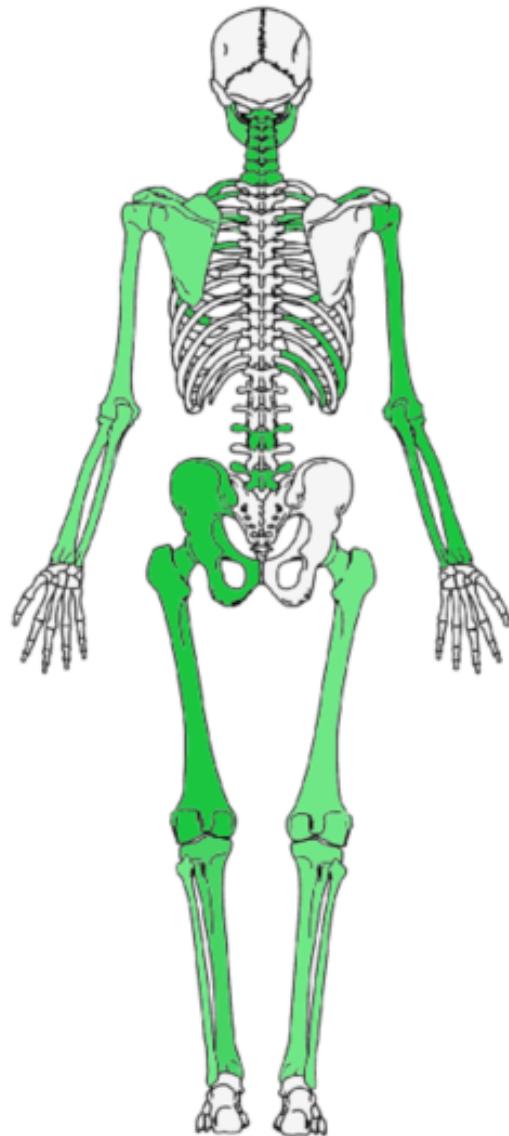
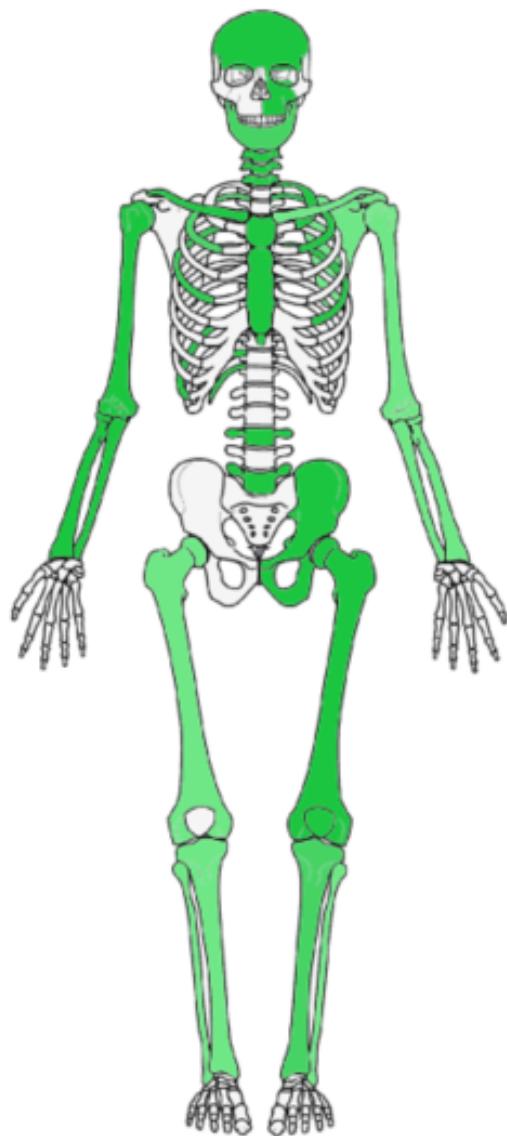
Skelet-o-matic

Complete ($\geq 95\%$) = Dark Green

Incomplete ($25 \leq x \leq 94\%$) = Green

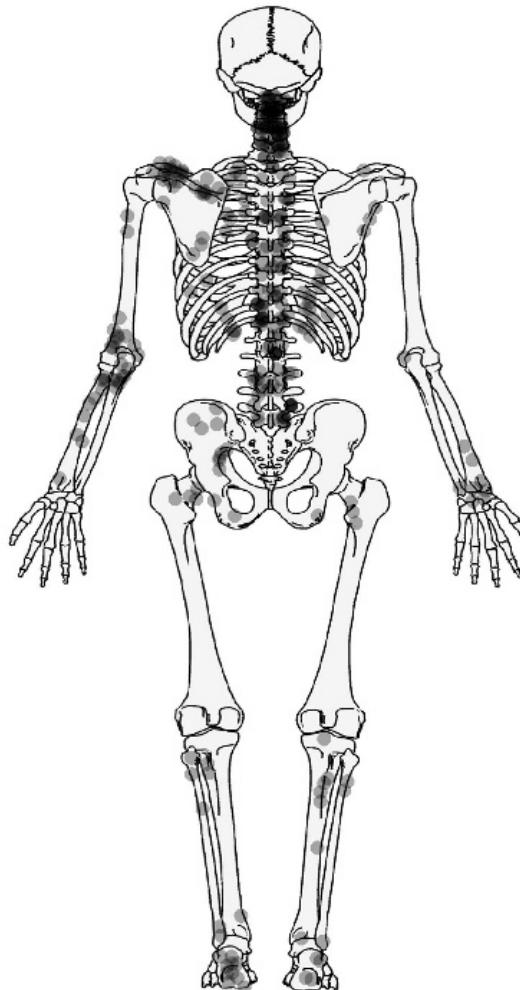
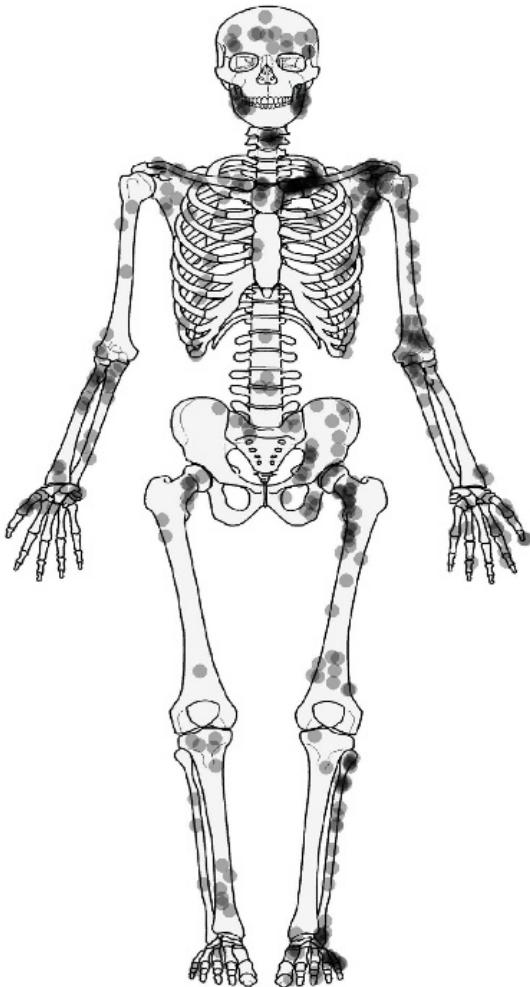
Fragmentary ($\leq 24\%$) = Light Green

Absent = Pale grey



- Absent
- Complete (>95%)
- Incomplete (25% <x<94%)
- Fragmentary (<24%)

Cross Adaptation – Trauma Documentation in Large Samples



GAF_S002_U.csv - Notepad

File Edit Format View Help

","","x","y"

"1",75.2218891402715,78.810105472417
"2",76.1067873303168,77.9214865536474
"3",26.1732466063348,77.9214865536474
"4",26.5524886877828,77.9214865536474
"5",26.9317307692308,77.6993318239549
"6",27.1845588235294,77.9214865536474
"7",27.5638009049774,78.1436412833398
"8",68.0162895927602,63.0371196642554
"9",68.3955316742082,63.925738583025
"10",69.1540158371041,61.0377270970236
"11",68.9011877828054,60.3712629079463
"12",68.5219457013575,59.7047987188691
"13",68.7747737556561,60.3712629079463
"14",68.2691176470588,59.2604892594843
"15",11.0035633484163,53.4844662874814
"16",29.3335972850679,7.05412778176598
"17",29.3335972850679,7.72059197084323

Skelet-o-matic
demo...