

## Using the Microsoft Visual Basic Macro EMM\_MACRO

This macro was written in Microsoft Visual Basic for use with Microsoft Excel. It computes cross-sectional geometric properties from biplanar radiographic images using the eccentric ellipse model (EEM) described in detail by Milgrom et al. (1989) and Ohman (1993). The Macro was first implemented in:

O'Neill MC, Ruff CB. 2004. Estimating human long bone cross-sectional geometric properties: a comparison of noninvasive methods. *J. Hum. Evol.* 47:??-??

### A. General Instructions

The EMM\_Macro is very simple and works in the same manner as a cell function. To begin, enter your data in the columns G through N:

AP	ap	ac	pc	ML	ml	mc	lc
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AP = anteriorposterior external breadth

ap = anteriorposterior breadth of medullary cavity. Computed automatically as AP-(ac+pc).

Leave blank (see below for explanation).

ac = anterior cortical thickness

pc = posterior cortical thickness

ML = mediolateral external breadth

ml = mediolateral breadth of the medullary cavity. Computed automatically as ML-(mc+lc).

Leave blank (see below for explanation).

mc = medial cortical thickness

lc = lateral cortical thickness

Once the data is entered the Macro is implemented by going to TOOLS, scrolling down to MACRO, and then clicking on MACROS. Make sure "EccentricEllipseMacro" is highlighted and then click RUN. This will compute the cross-sectional geometric properties using the eccentric ellipse model for 150 sections.

The output will appear in columns P through W:

<b>TA</b>	<b>MA</b>	<b>CA</b>	<b>Xo</b>	<b>Yo</b>	<b>Ix</b>	<b>Iy</b>	<b>J</b>
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TA = total area

MA = medullary area

CA = cortical area

Xo = the new section centroid

Yo = the new section centroid

Ix = second moment of area about M-L (x) axis

Iy = second moment of area about A-P (y) axis

J = polar second moment of area

See Table 1 of O'Neill & Ruff (2004) for the biomechanical interpretations of these variables.

### B. Notes on the EEM\_MACRO:

1. For the EEM to be computed, the following statement must be true:  $AP-(ac+pc) = ap$ . However, when all of these measurements are taken by hand (calipers) the following is almost always true:  $AP-(ac+pc) \neq ap$ . We assume this to be the product of measurement error in ap and, therefore compute ap from the external and cortical breadths. This is different from Dr. Jim Ohman's program GEOXRAY, which automatically adjusts the cortical dimensions if the above statement is not true.
2. For data sets with more than 150 sections, the program can be easily adjusted to accommodate more sections. To do this go to TOOLS, scroll down to MACRO, and then click on MACROS. Make sure

“EccentricEllipseMacro” is highlighted and then click EDIT. A page containing the code for the macro should appear and will include code such as:

```
Range("H2").Select
ActiveCell.FormulaR1C1 = "=RC[-1]-(RC[1]+RC[2])"
Selection.AutoFill Destination:=Range("H2:H151"), Type:=xlFillDefault
```

This particular code is for computing ap breadth of the medullary cavity. To increase the number of rows that the EEM\_MACRO can accommodate adjust the Range from 151 to 1+ the number of rows you need. For example, to increase the range to accommodate 200 sections the code would now read:

```
Range("H2").Select
ActiveCell.FormulaR1C1 = "=RC[-1]-(RC[1]+RC[2])"
Selection.AutoFill Destination:=Range("H2:H201"), Type:=xlFillDefault
```

This needs to be done for all 10 equations.

3. DO NOT add or delete columns in the EXCEL file. Doing so may result in the Macro computing variables incorrectly, since the equations are referenced to specific columns. Tinker at your own risk.
4. Finally it is the users responsibility to verify that the program is computing the variables properly. One possibility for testing this is to compare a few results obtained from this Macro with those obtained from GEOXRAY (Ohman, 1993). Data from one individual (femur 50% section) is provided for a test run of the Macro.

### **C. References**

- Milgrom C, Giladi M, Simkin A, Rand N, Kedem R, Kashtan H, Stien M, Gomori M. 1989. The area moment of inertia of the tibia: a risk for stress fractures. *J. Biomech.* 22: 1243-1248.
- Ohman JC. 1993. Computer software for estimating coressntional geometric properties of long bones with concentric and eccentric elliptical models *J. Hum. Evol.* 25: 217-227.