## Estimating Height using Large Bones

Measuring bones like the humerus or femur can help determine the approximate height of an individual. Many databases have been established that use mathematical relationships to calculate the overall height of an individual from one of the long bones of the body. There are separate tables for males, females, and different races.

The mathematical formula between bone length and estimated height varies depending on the race and the bone used. If the race and sex of an individual are known, the calculation of height will be more accurate.

| Bone length for American Caucasian males. |  |  |
| :---: | :---: | :---: |
| Factor $\times$ bone length | plus | Accuracy |
| Height (cm) $=2.89 \times$ humerus | $+78.10 \mathrm{~cm}$ | $\pm 4.57$ |
| Height (cm) $=3.79 \times$ radius | $+79.42 \mathrm{~cm}$ | $\pm 4.66$ |
| Height ( cm ) $=3.76 \times$ ulna | $+75.55 \mathrm{~cm}$ | $\pm 4.72$ |
| Height (cm) $=2.32 \times$ femur | $+65.53 \mathrm{~cm}$ | $\pm 3.94$ |
| Height (cm) $=2.60 \times$ fibula | $+75.50 \mathrm{~cm}$ | $\pm 3.86$ |
| Height (cm) $=1.82 \times$ (humerus + radius $)$ | $+67.97 \mathrm{~cm}$ | $\pm 4.31$ |
| Height (cm) $=1.78 \times$ (humerus + ulna) | $+66.98 \mathrm{~cm}$ | $\pm 4.37$ |
| Height $(\mathrm{cm})=1.31 \times($ femur + fibula $)$ | $+63.05 \mathrm{~cm}$ | $\pm 3.62$ |
| Bone length for American Caucasian females. |  |  |
| Factor $\times$ bone length | plus | Accuracy |
| Stature (cm) $=3.36 \times$ humerus | $+57.97 \mathrm{~cm}$ | $\pm 4.45$ |
| Stature (cm) $=4.74 \times$ radius | $+54.93 \mathrm{~cm}$ | $\pm 4.24$ |
| Stature (cm) $=4.27 \times$ ulna | $+57.76 \mathrm{~cm}$ | $\pm 4.30$ |
| Stature (cm) $=2.47 \times$ femur | + 54.10 cm | $\pm 3.72$ |
| Stature ( cm ) $=2.93 \times$ fibula | + 59.61 cm | $\pm 3.57$ |
| Bone length for Caucasians, both sexes. |  |  |
| Factor $\times$ bone length | plus | Accuracy |
| Stature $=4.74 \times$ humerus | + 15.26 cm | $\pm 4.94$ |
| Stature $=4.03 \times$ radius | + 69.96 cm | $\pm 4.98$ |
| Stature $=4.65 \times$ ulna | $+47.96 \mathrm{~cm}$ | $\pm 4.96$ |
| Stature $=3.10 \times$ femur | $+28.82 \mathrm{~cm}$ | $\pm 3.85$ |
| Stature $=3.02 \times$ tibia | $+58.94 \mathrm{~cm}$ | $\pm 4.11$ |
| Stature $=3.78 \times$ fibula | $+30.15 \mathrm{~cm}$ | $\pm 4.06$ |
| Bone length for African-American and African males. |  |  |
| Factor $\times$ bone length | plus | Accuracy |
| Height (cm) $=2.88 \times$ humerus | $+75.48 \mathrm{~cm}$ | $\pm 4.23$ |
| Height $(\mathrm{cm})=3.32 \times$ radius | $+85.43 \mathrm{~cm}$ | $\pm 4.57$ |
| Height ( cm ) $=3.20 \times$ ulna | $+82.77 \mathrm{~cm}$ | $\pm 4.74$ |
| Height (cm) $=2.10 \times$ femur | $+72.22 \mathrm{~cm}$ | $\pm 3.91$ |
| Height (cm) $=2.34 \times$ fibula | $+80.07 \mathrm{~cm}$ | $\pm 4.02$ |
| Height (cm) $=1.66 \times$ (humerus + radius $)$ | $+73.08 \mathrm{~cm}$ | $\pm 4.18$ |
| Height (cm) $=1.65 \times$ (humerus + ulna) | $+70.67 \mathrm{~cm}$ | $\pm 4.23$ |
| Height $(\mathrm{cm})=1.20 \times($ femur + fibula $)$ | $+67.77 \mathrm{~cm}$ | $\pm 3.63$ |
| Bone length for African-American and African females. |  |  |
| Factor $\times$ bone length | plus | Accuracy |
| Stature $=3.08 \times$ humerus | $+64.67 \mathrm{~cm}$ | $\pm 4.25$ |
| Stature $=3.67 \times$ radius | $+71.79 \mathrm{~cm}$ | $\pm 4.59 \mathrm{a}$ |
| Stature $=3.31 \times$ ulna | $+75.38 \mathrm{~cm}$ | $\pm 4.83$ |
| Stature $=2.28 \times$ femur | $+59.76 \mathrm{~cm}$ | $\pm 3.41$ |
| Stature $=2.49 \times$ fibula | $+70.90 \mathrm{~cm}$ | $\pm 3.80$ |
| Bone length for All ethnic groups or, if ethnicity is unknown, both sexes. |  |  |
| Factor $\times$ bone length | plus | Accuracy |
| Stature $=4.62 \times$ humerus | $+19.00 \mathrm{~cm}$ | $\pm 4.89$ |
| Stature $=3.78 \times$ radius | $+74.70 \mathrm{~cm}$ | $\pm 5.01$ |
| Stature $=4.61 \times$ ulna | $+46.83 \mathrm{~cm}$ | $\pm 4.97$ |
| Stature $=2.71 \times$ femur | $+45.86 \mathrm{~cm}$ | $\pm 4.49$ |
| Stature $=3.01 \times$ femur | $+32.52 \mathrm{~cm}$ | $\pm 3.96$ |
| Stature $=3.29 \times$ tibia | $+47.34 \mathrm{~cm}$ | $\pm 4.15$ |
| Stature $=3.59 \times$ fibula | $+36.31 \mathrm{~cm}$ | $\pm 4.10$ |

Calculate the approximate height of the person if a humerus bone was found in each of the following situations. Show your work.

1. Caucasian male femur of 50.6 cm
2. African-American female femur of 49.5 cm
3. A Caucasian person, sex unknown, tibia of 34.2 cm
4. Caucasian female humerus of 33.4 cm
5. African-American male humerus of 41.1 cm
6. Person of unknown sex or ethnic group, humerus of 31.6 cm
