Gravity and Levity

Planet	Distance from Sun ×Earth	Distance from Sun km×10^7	Mass ×Earth	Mass kg×10^{24}
Mercury	0.31–0.47	4.64–7.03	0.06	0.36
Venus	0.72	10.77	0.82	4.90
Earth	1.00	14.96	1.00	5.98
Mars	1.52	22.74	0.11	0.66
Jupiter	5.20	77.79	317.8	1897.97
Saturn	9.54	142.72	95.2	586.55
Uranus	19.22	287.53	14.6	87.19
Neptune	30.06	448.70	17.2	102.72

In AU
$1\,\mathrm{AU} = 14.96\times10^{10}$ m

Mass of Earth
$= 5.9722\times10^{24}$ kg

Data vary slightly according to source

Venus *vs* One Fat Lady

The gravity from a mass m at a distance r is proportional to $\dfrac{m}{r^2}$.

So the gravities from masses m_1, m_2 at distances r_1, r_2 are in the ratio

$$\frac{\text{gravity}_1}{\text{gravity}_2} = \frac{m_1}{m_2}\times\frac{r_2^2}{r_1^2}$$

Now consider that you are quite close to a Fat Lady who weighs $m_1 = 150\,$kg, and that your centres of mass are $r_1 = 1$ metre apart (a Fat Lady is almost spherical); and compare the attraction you feel towards the Fat Lady with the attraction you feel towards Venus.

The mass of Venus is $m_2 = 4.90\times10^{24}$kg, which is 3.27×10^{22} times the mass m_1 of the Fat Lady.

The closest Venus comes to Earth is $(14.96-10.77 = 4.19)\times10^7$ km, which is $r_2 = 4.19\times10^{10}$ metres, $= 4.19\times10^{10}\times r_1$. Therefore the ratio

$$\frac{\text{Attraction of Fat Lady}}{\text{Attraction of Venus}} = \frac{m_1}{m_2}\times\frac{r_2^2}{r_1^2} = \frac{1}{3.27\times10^{22}}\times(4.19\times10^{10})^2 = 0.0537$$

So the Fat Lady is only a twentieth as attractive as Venus, when Venus makes her closest approach to you! But when Venus turns her back on you, becoming remote and moody, it is the other way round.

At her most remote, Venus is $r_2 = (14.96+10.77 = 25.73)\times10^7$ km from Earth, and then her attractiveness is reduced by a factor of $(25.73/4.192)^2 = 37.71$, whereupon

$$\frac{\text{Attraction of Fat Lady}}{\text{Attraction of Venus}} = 0.0537\times37.71 = 2.025$$

and the Fat Lady is twice as attractive as Venus. They are equal when $r_2^2/r_1^2 = m_2/m_1 = 3.27\times10^{22}$, i.e. $r_2 = 1.81\times10^{11}$ m $= 18.1\times10^7$ km. As Venus trots the pavement in her orbit round *The Sun*, she spends almost 51% of her time being less attractive than the Fat Lady.

Venus *vs* Tall Slim Beauty *and* Tall Slim Beauty *vs* Fat Lady

The Tall Slim Beauty weighs in at $m_1 = 9$ stone $= 126$lb $\equiv 57.3$kg, so for her $m_1 = 57.3/150 = 0.38$ of the Fat Lady's m_1. So with 1 metre between your centres of gravity, she would be $0.38\times0.0537 = 0.0204$, or one fiftieth, as attractive as Venus at her closest. Venus would have to be $(18.1/\sqrt{0.38} = 29.36)\times10^7$ km from Earth to be less attractive, which doesn't happen ($r_2 \le 25.73\times10^7$ km)—the Tall Slim Beauty at 1 metre is always less attractive than Venus.

To be more attractive than the Fat Lady, she would need to get her centre of gravity within $\sqrt{0.38} = 0.62$ metres of yours. At a distance of 1 metre she is only 38% as attractive as the Fat Lady.