Model: Weight Lifting

```
>
> restart;
```

```
> makePoints:=proc(xlist,ylist)
  local p,i:
  p:=NULL:
  for i to nops(xlist) do
    p:=p,[xlist[i],ylist[i]]:
  od:
  [p];
  end;
```

$$makePoints := \mathbf{proc}(xlist, ylist) \quad \textbf{(1)}$$

$$\quad \mathbf{local}\ p, i;$$

$$\quad p := NULL;\ \mathbf{for}\ i\ \mathbf{to}\ nops(xlist)\ \mathbf{do}\ p := p, [xlist[i], ylist[i]]\ \mathbf{end\ do};\ [p]$$

$$\mathbf{end\ proc}$$

```
> functionToList:=proc(lst,f)
  local p,i:
  p:=NULL:
  for i to nops(lst) do
    p:=p,f(lst[i]):
  od:
  [p];
  end;
```

$$functionToList := \mathbf{proc}(lst, f) \quad \textbf{(2)}$$

$$\quad \mathbf{local}\ p, i;$$

$$\quad p := NULL;\ \mathbf{for}\ i\ \mathbf{to}\ nops(lst)\ \mathbf{do}\ p := p, f(lst[i])\ \mathbf{end\ do};\ [p]$$

$$\mathbf{end\ proc}$$

```
> with(plots):
  plotPropModel:=proc(p,i)
  local slpe,liner,xmax,j,p1,p2:
  slpe:=(p[i][2]-0)/(p[i][1]-0):
  print(`Slope = `,evalf(slpe));
  liner:=t->slpe*t:
  xmax:=-infinity:
  for j to nops(p) do
    if p[j][1] > xmax then
      xmax:=p[j][1]:
    fi:
  od:
  p1:=plot(p,style=point,symbol=circle):
  p2:=plot(liner,0..xmax,color=navy):
```

```
   display({p1,p2});
   end;
```

```
plotPropModel := proc(p, i)
    local slpe, liner, xmax, j, p1, p2;
    slpe := p[i][2]/p[i][1];
    print(Slope = , evalf(slpe));
    liner := t→slpe*t;
    xmax := -∞;
    for j to nops(p) do if xmax < p[j][1] then xmax := p[j][1] end if end do;
    p1 := plot(p, style = point, symbol = circle);
    p2 := plot(liner, 0..xmax, color = navy);
    plots:-display({p1, p2})
end proc
```

(3)

```
> #
  # Now onto weight lifting
  #
```

```
> lifts:=[534.6,578.7,628.3,677.9,738.5,804.7,843.3,881.8];
  snatch:=[231.5,259,275.6,297.6,319.7,358.3,374.8,385.8];
  jerk:=[303.1,319.7,352.7,380.3,418.9,446.4,468.5,496];
  weights:=[114.5,123.5,132.5,149.0,165.5,182.0,198.5,242.5];
```

$$lifts := [534.6, 578.7, 628.3, 677.9, 738.5, 804.7, 843.3, 881.8]$$

$$snatch := [231.5, 259, 275.6, 297.6, 319.7, 358.3, 374.8, 385.8]$$

$$jerk := [303.1, 319.7, 352.7, 380.3, 418.9, 446.4, 468.5, 496]$$

$$weights := [114.5, 123.5, 132.5, 149.0, 165.5, 182.0, 198.5, 242.5] \quad \textbf{(4)}$$

```
> wl:=makePoints(weights,lifts);
```

$$wl := [[114.5, 534.6], [123.5, 578.7], [132.5, 628.3], [149.0, 677.9], [165.5, 738.5], [182.0, 804.7], [198.5, 843.3], [242.5, 881.8]] \quad \textbf{(5)}$$

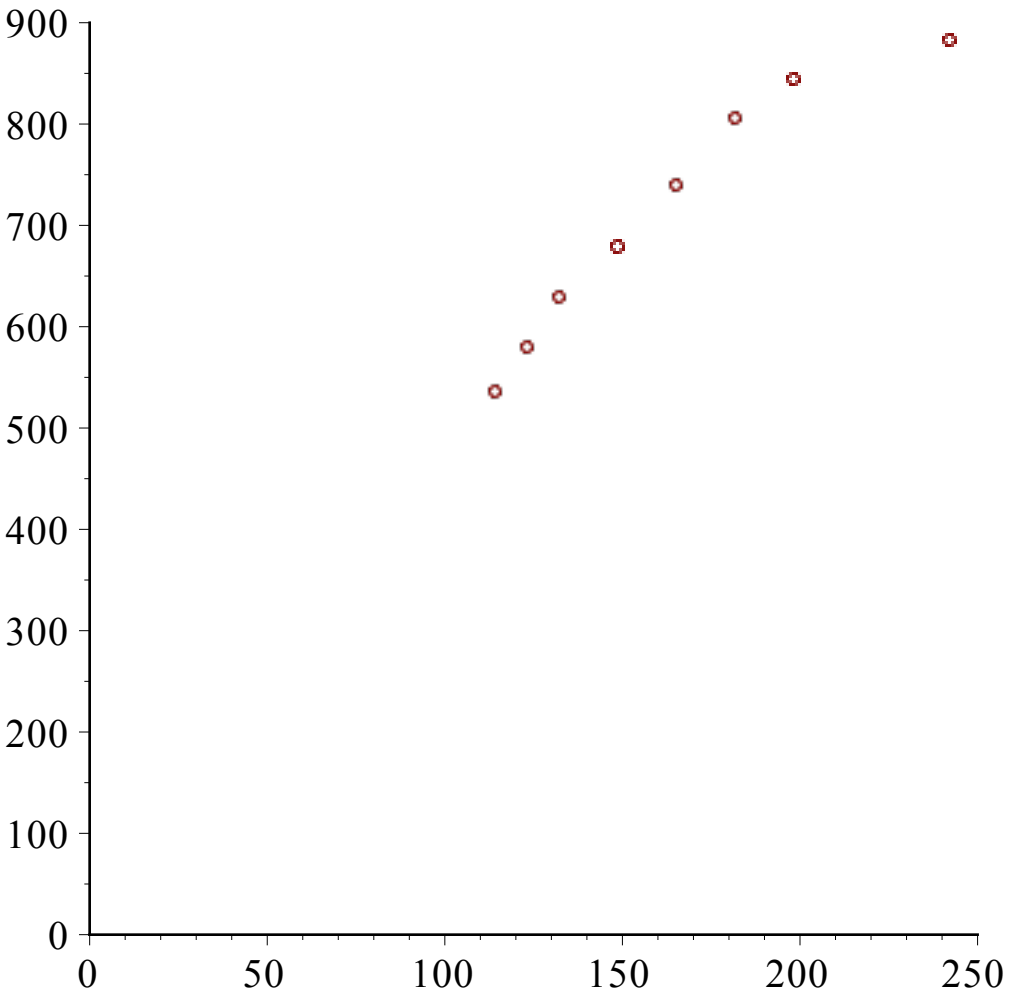
```
> ws:=makePoints(weights,snatch);
```

$$ws := [[114.5, 231.5], [123.5, 259], [132.5, 275.6], [149.0, 297.6], [165.5, 319.7], [182.0, 358.3], [198.5, 374.8], [242.5, 385.8]] \quad \textbf{(6)}$$

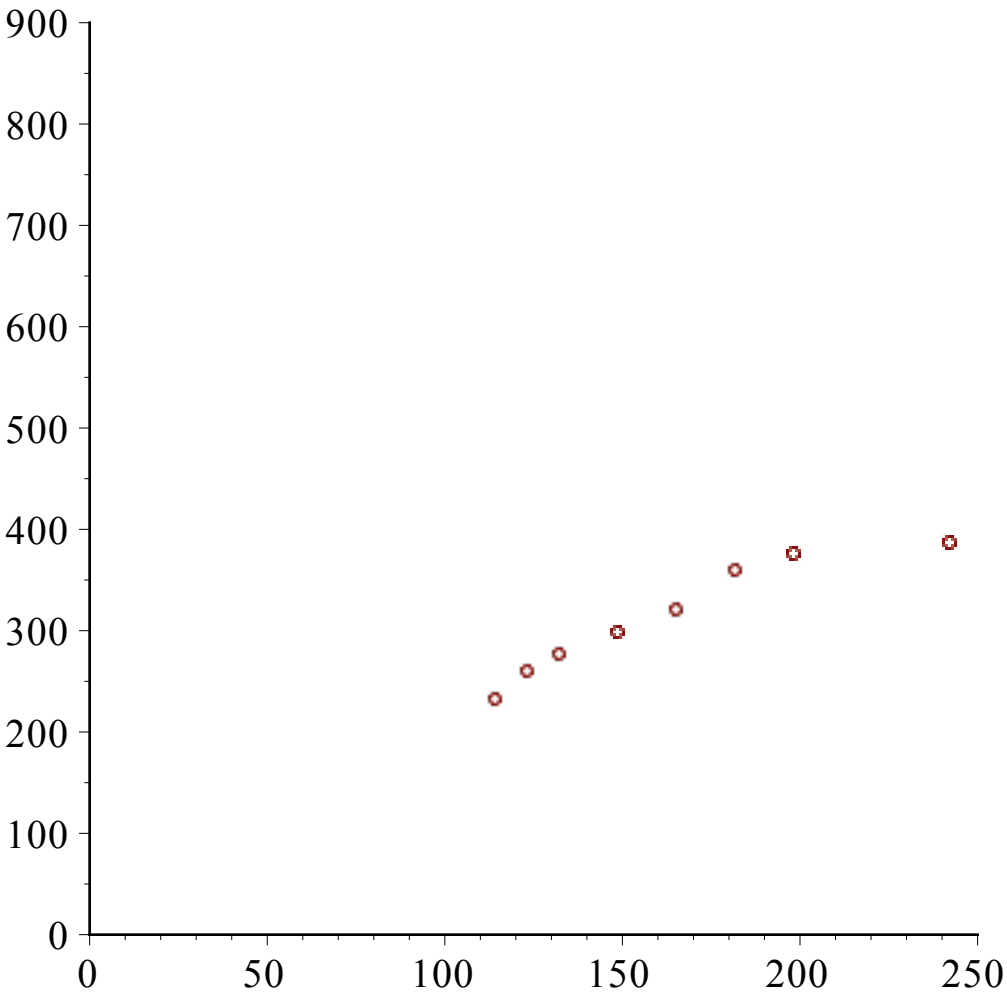
```
> wj:=makePoints(weights,jerk);
```

$$wj := [[114.5, 303.1], [123.5, 319.7], [132.5, 352.7], [149.0, 380.3], [165.5, 418.9], [182.0, 446.4], [198.5, 468.5], [242.5, 496]] \quad \textbf{(7)}$$

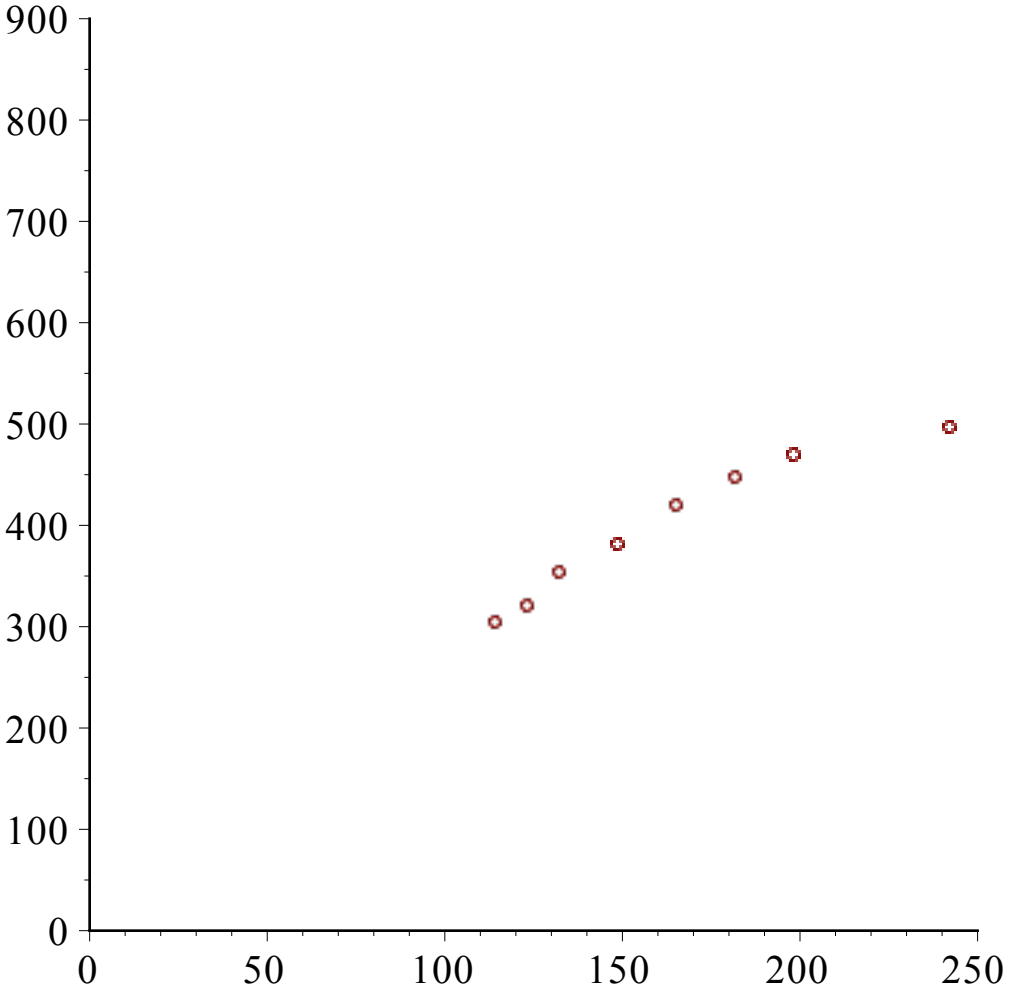
```
> plot(wl,0..250,0..900,style=point,symbol=circle);
```




```
> plot(ws,0..250,0..900,style=point,symbol=circle);
```




```
> plot(wj,0..250,0..900,style=point,symbol=circle);
```




```
> f := x→x^(2/3);
```

$$f := x \to x^{2/3} \quad \textbf{(8)}$$

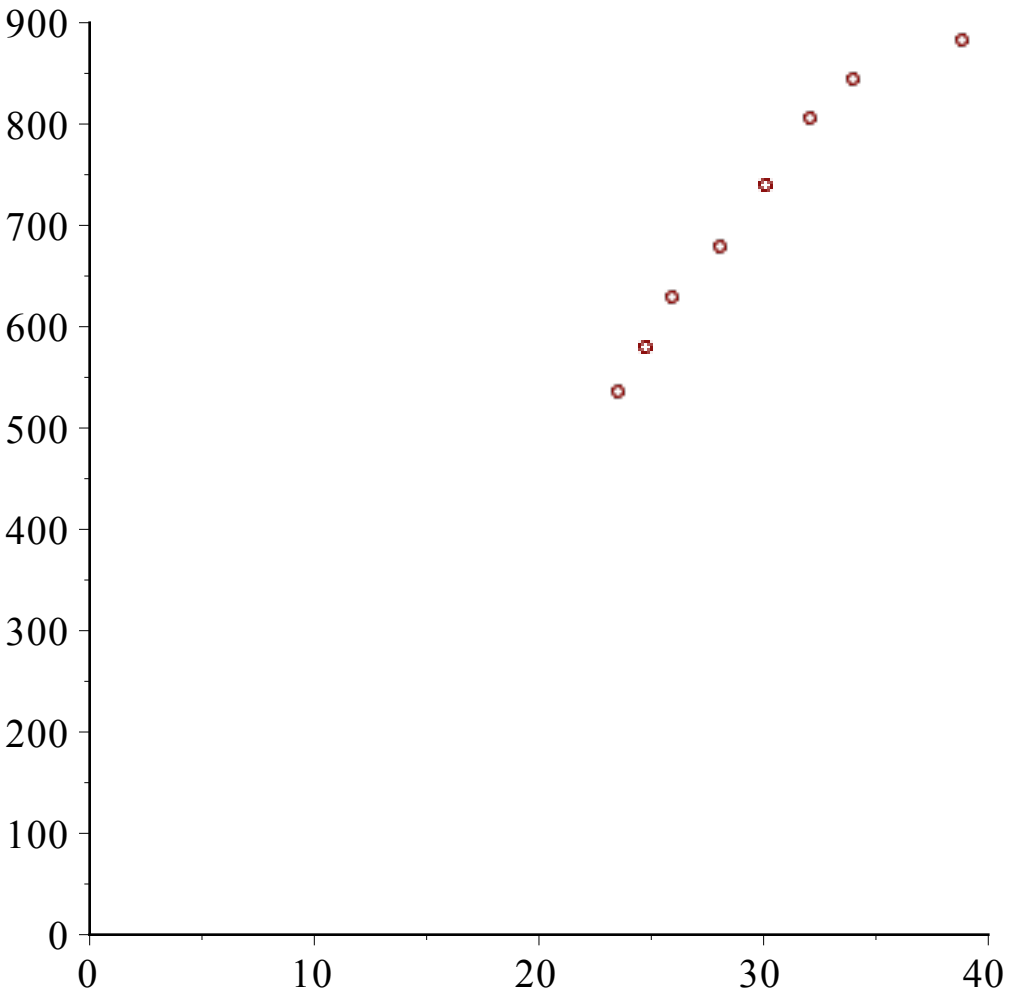
```
> W := functionToList(weights, f);
```

$$W := [23.57963027, 24.79959785, 25.99025769, 28.10546957, 30.14384621, 32.11546826, 34.02830688, 38.88730341] \quad \textbf{(9)}$$

```
> Wl := makePoints(W, lifts);
```

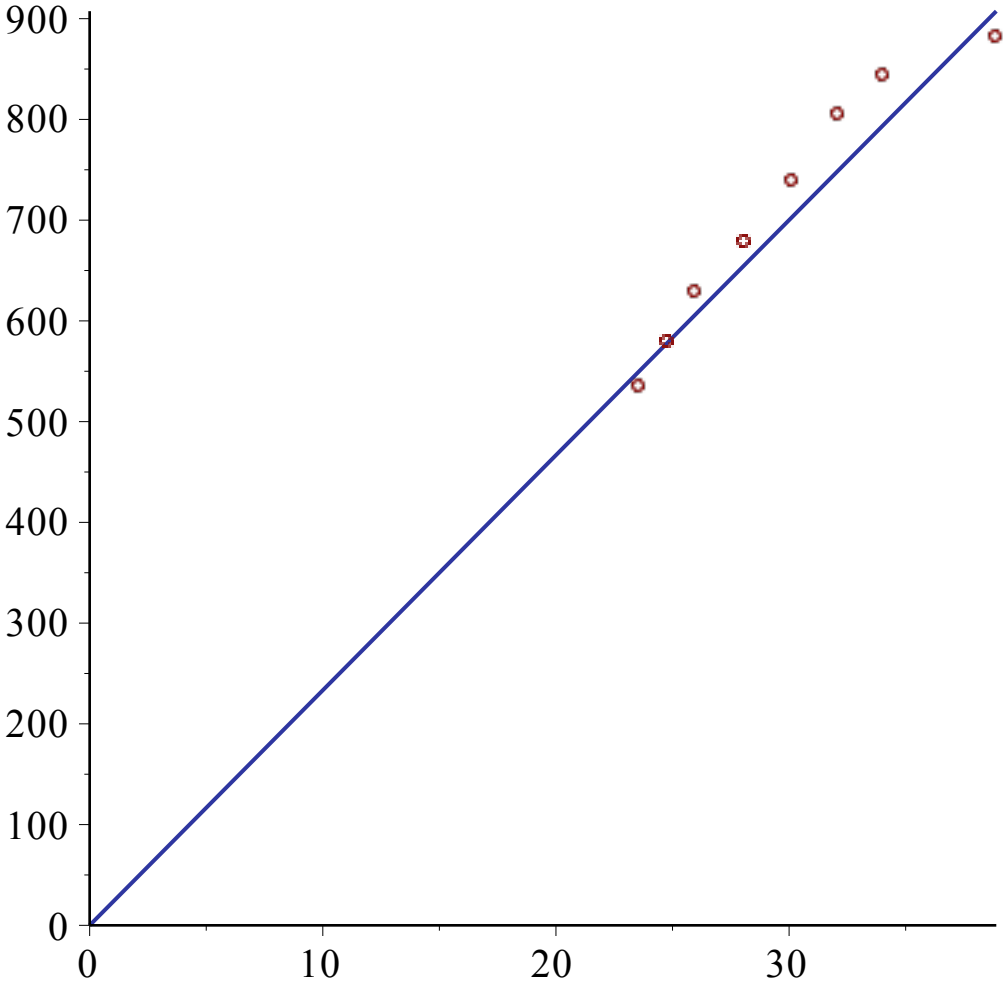
$$Wl := [[23.57963027, 534.6], [24.79959785, 578.7], [25.99025769, 628.3], [28.10546957, 677.9], [30.14384621, 738.5], [32.11546826, 804.7], [34.02830688, 843.3], [38.88730341, 881.8]] \quad \textbf{(10)}$$

```
> plot(Wl, 0..40, 0..900, style = point, symbol = circle);
```



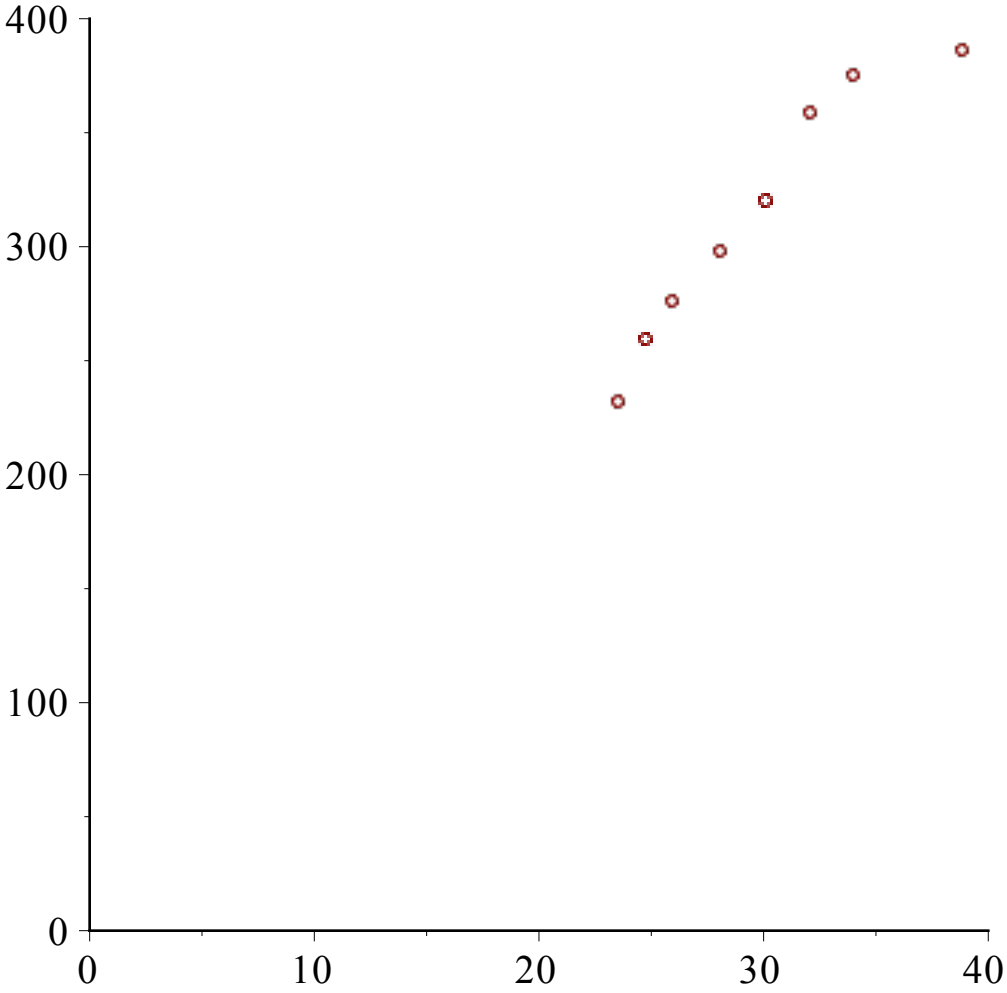

```
> plotPropModel(Wl, 2);
```

Slope = , 23.33505581



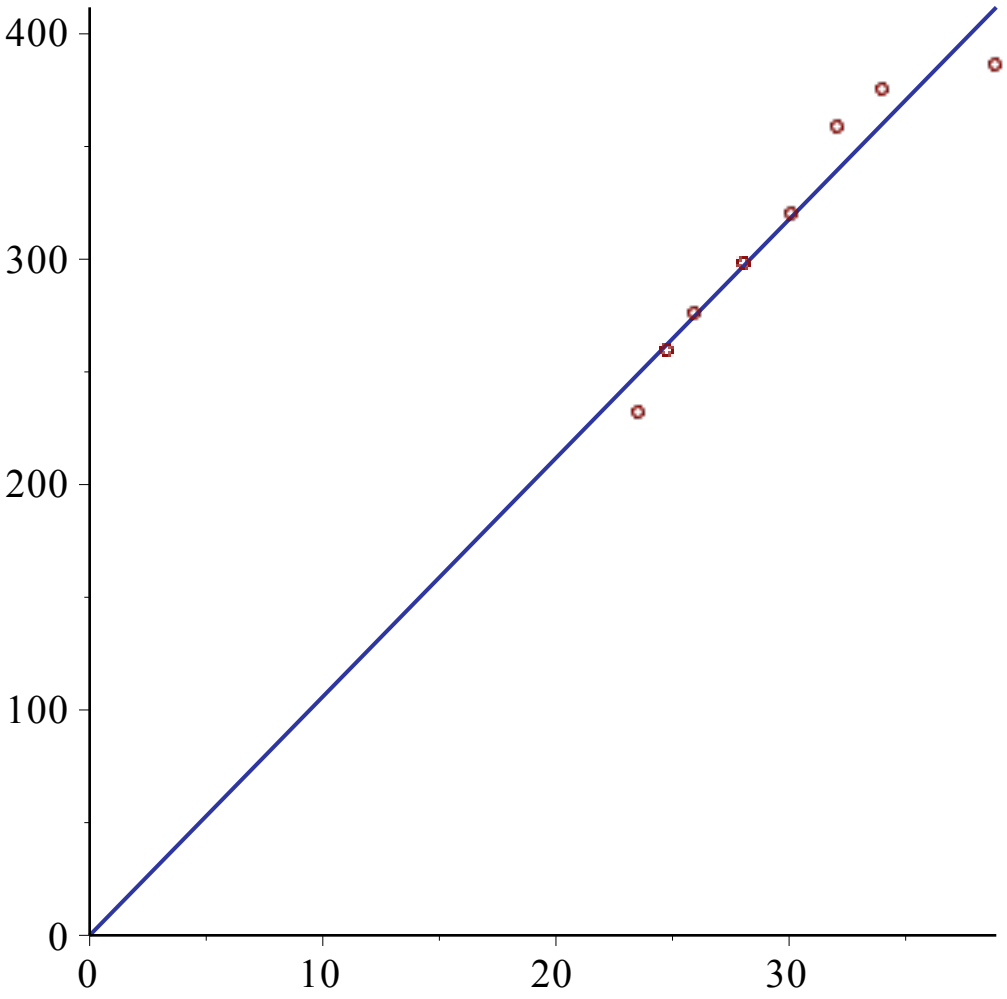

```
> Ws := makePoints(W, snatch);
  plot(Ws, 0..40, 0..400, style = point, symbol = circle);
```

```
Ws := [[23.57963027, 231.5], [24.79959785, 259], [25.99025769, 275.6], [28.10546957,
    297.6], [30.14384621, 319.7], [32.11546826, 358.3], [34.02830688, 374.8],
    [38.88730341, 385.8]]
```



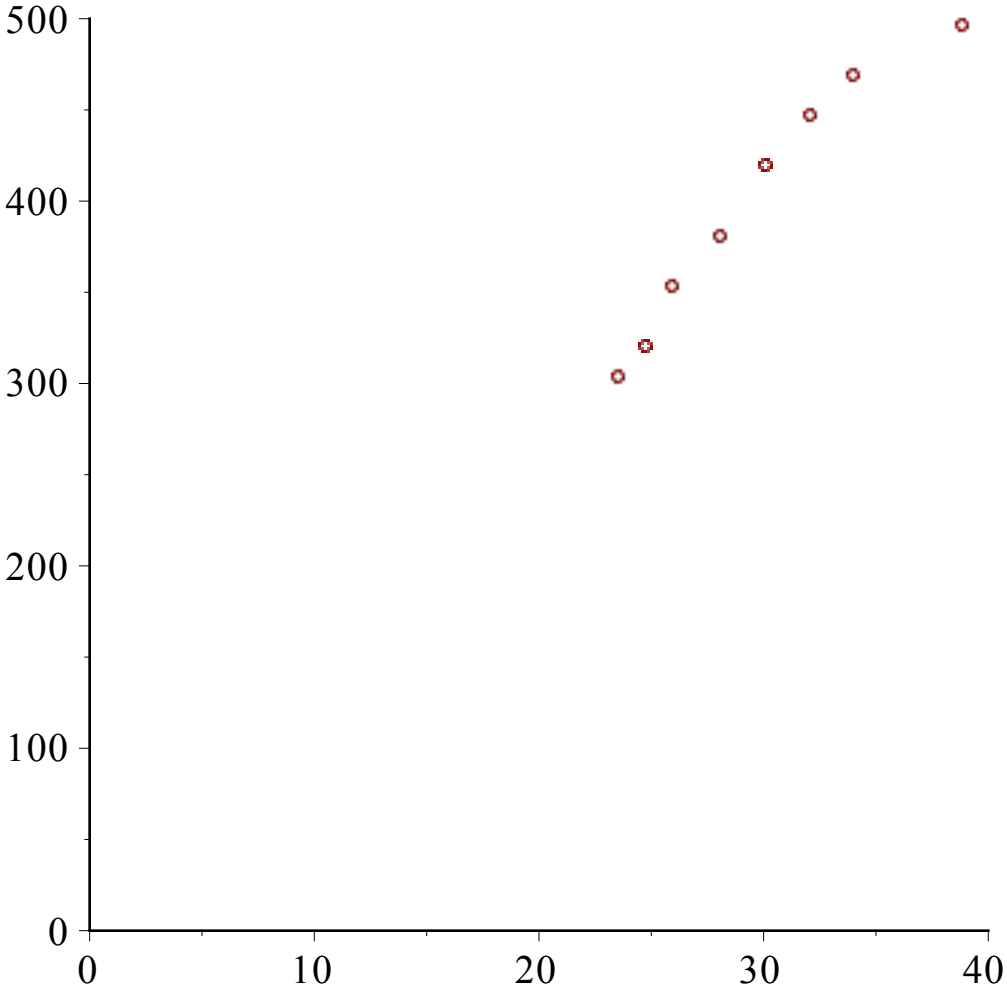

```
> plotPropModel(Ws, 4);
```

Slope = , 10.58868628



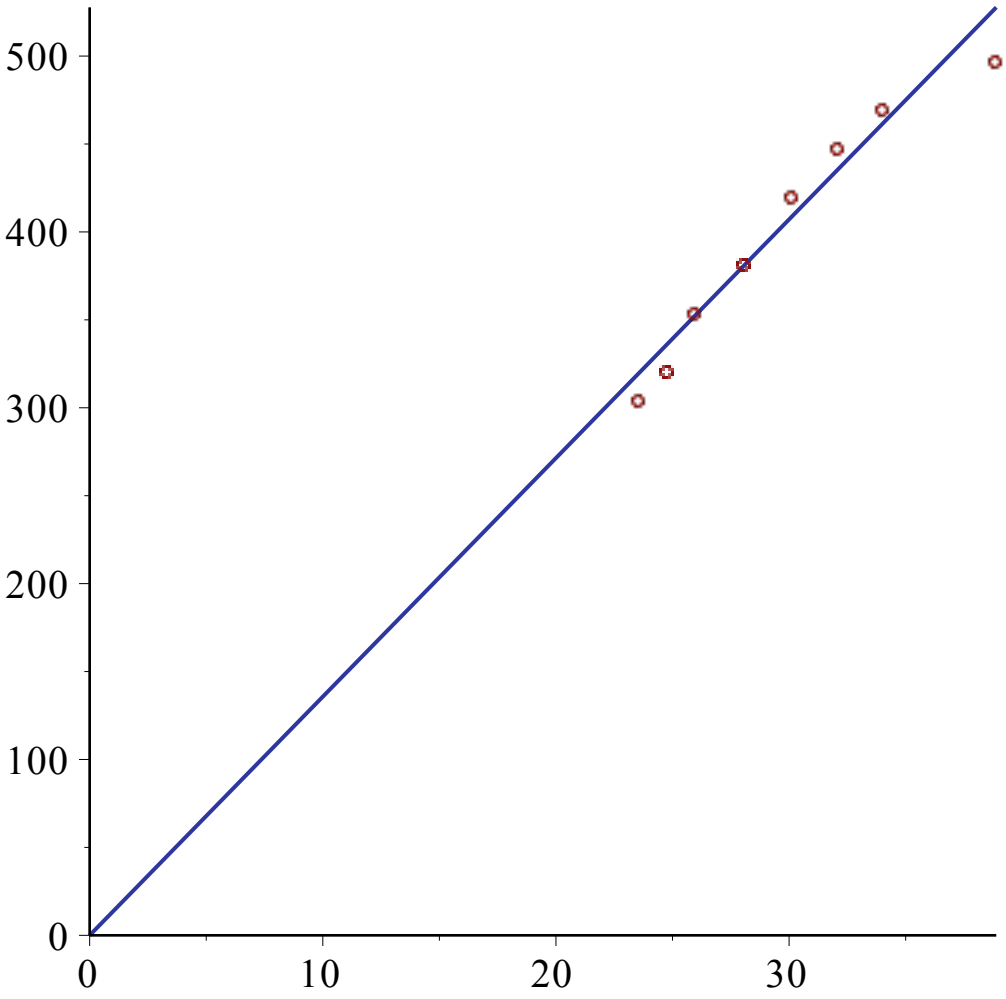

```
> Wj := makePoints(W, jerk);
  plot(Wj, 0..40, 0..500, style = point, symbol = circle);
```

```
Wj := [[23.57963027, 303.1], [24.79959785, 319.7], [25.99025769, 352.7], [28.10546957,
    380.3], [30.14384621, 418.9], [32.11546826, 446.4], [34.02830688, 468.5],
    [38.88730341, 496]]
```




```
> plotPropModel(Wj, 3);
```

Slope = , 13.57046953




```
> for i from 1 to nops(W) do
    w := weights[i]:
    j := jerk[i]:
    mdl := 13.570·(w)^(2/3):
    reldiff := (mdl − j)/j·100;
    print(w, j, mdl, reldiff);
  od:
```

114.5, 303.1, 319.9755828, 5.567661762

123.5, 319.7, 336.5305428, 5.264480075

132.5, 352.7, 352.6877969, −0.003459909271

149.0, 380.3, 381.3912221, 0.2869371812

165.5, 418.9, 409.0519931, −2.350920721

182.0, 446.4, 435.8069043, −2.373005309

198.5, 468.5, 461.7641244, −1.437753597

$$242.5,\ 496,\ 527.7007073,\ 6.391271633 \tag{11}$$

```
> # If a new weight lifter has weight 222.2 lbs, what woudl you expect hi to lift in the jerk lift?
```

```
> 13.570·222.2^(2/3);
```

$$497.8240619 \tag{12}$$

```
> # Now to traffic flow
  #
```

```
> flow := v→ v/(1.1·v + 0.054·v^2 + 15);
```

$$flow := v \to \frac{v}{1.1\,v + 0.054\,v^2 + 15} \tag{13}$$

```
> 5280/3600;
```

$$\frac{22}{15} \tag{14}$$

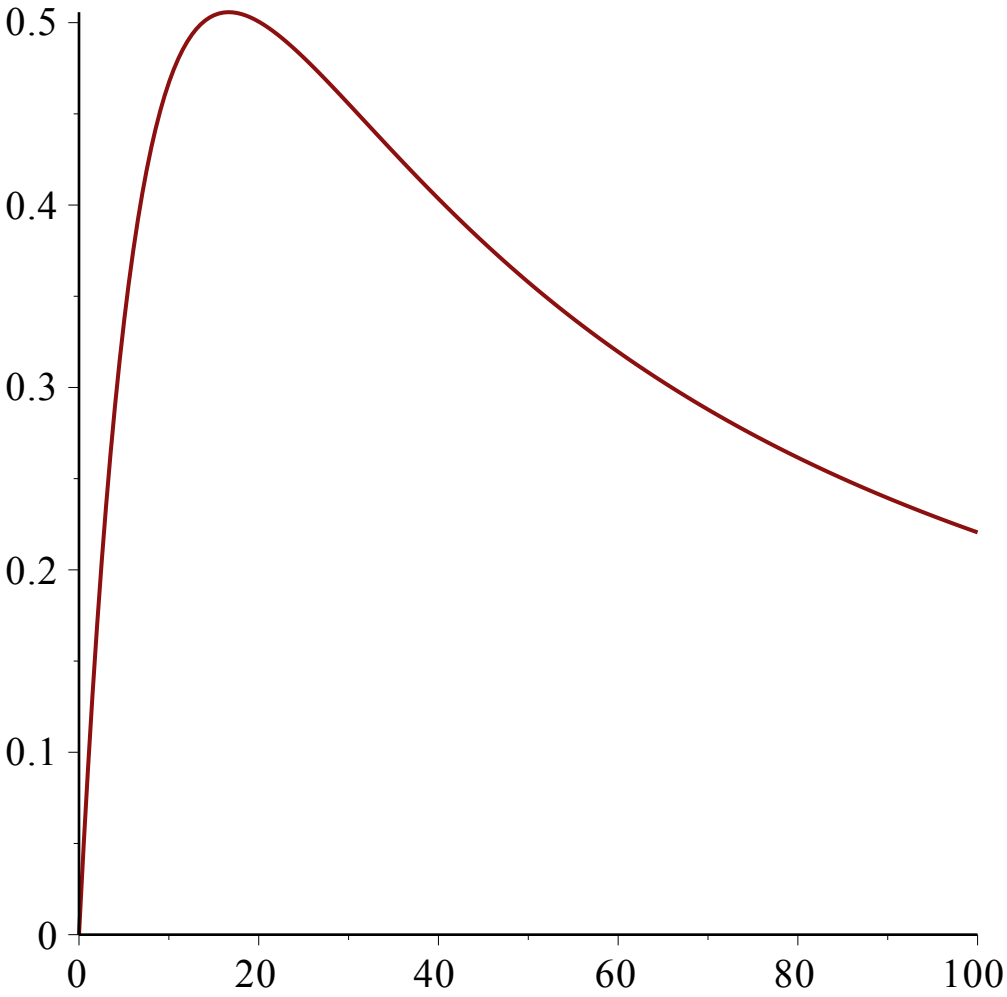
```
> flow := v→ v/(1.1·v + 0.054·v^2 + 15)·22/15;
```

$$flow := v \to \frac{22}{15}\ \frac{v}{1.1\,v + 0.054\,v^2 + 15} \tag{15}$$

```
> flow(80);
```

$$0.2615544658 \tag{16}$$

```
> plot(flow, 0..100);
```




```
> diff(flow(v), v);
```

$$\frac{22}{15\left(1.1\,v + 0.054\,v^2 + 15\right)} - \frac{22}{15}\,\frac{v\,(1.1 + 0.108\,v)}{\left(1.1\,v + 0.054\,v^2 + 15\right)^2} \tag{17}$$

```
> solve(% = 0, v);
```

$$-16.66666667,\ 16.66666667 \tag{18}$$

```
> flow := v→ v / (11/10·v + 54/1000·v^2 + 15) · 22/15;
```

$$flow := v \to \frac{22}{15}\,\frac{v}{\frac{11}{10}\,v + \frac{27}{500}\,v^2 + 15} \tag{19}$$

```
> diff(flow(v), v);
```

$$\frac{22}{15\left(\frac{11}{10}\,v + \frac{27}{500}\,v^2 + 15\right)} - \frac{22}{15}\,\frac{v\left(\frac{11}{10} + \frac{27}{250}\,v\right)}{\left(\frac{11}{10}\,v + \frac{27}{500}\,v^2 + 15\right)^2} \tag{20}$$

```
> solve(% = 0, v);
```

$$-\frac{50}{3}, \frac{50}{3} \tag{21}$$

```
> subs(v = 50/3, 11/10 · v + 54/1000 · v^2 + 15);
```

$$\frac{145}{3} \tag{22}$$

```
> evalf(%);
```

$$48.33333333 \tag{23}$$

```
> #Each driver should leave 48.3 feet between themselves and the vehicle's front bumer ahead.
```