

Feb 7, 2012

```
> with(plots):
```

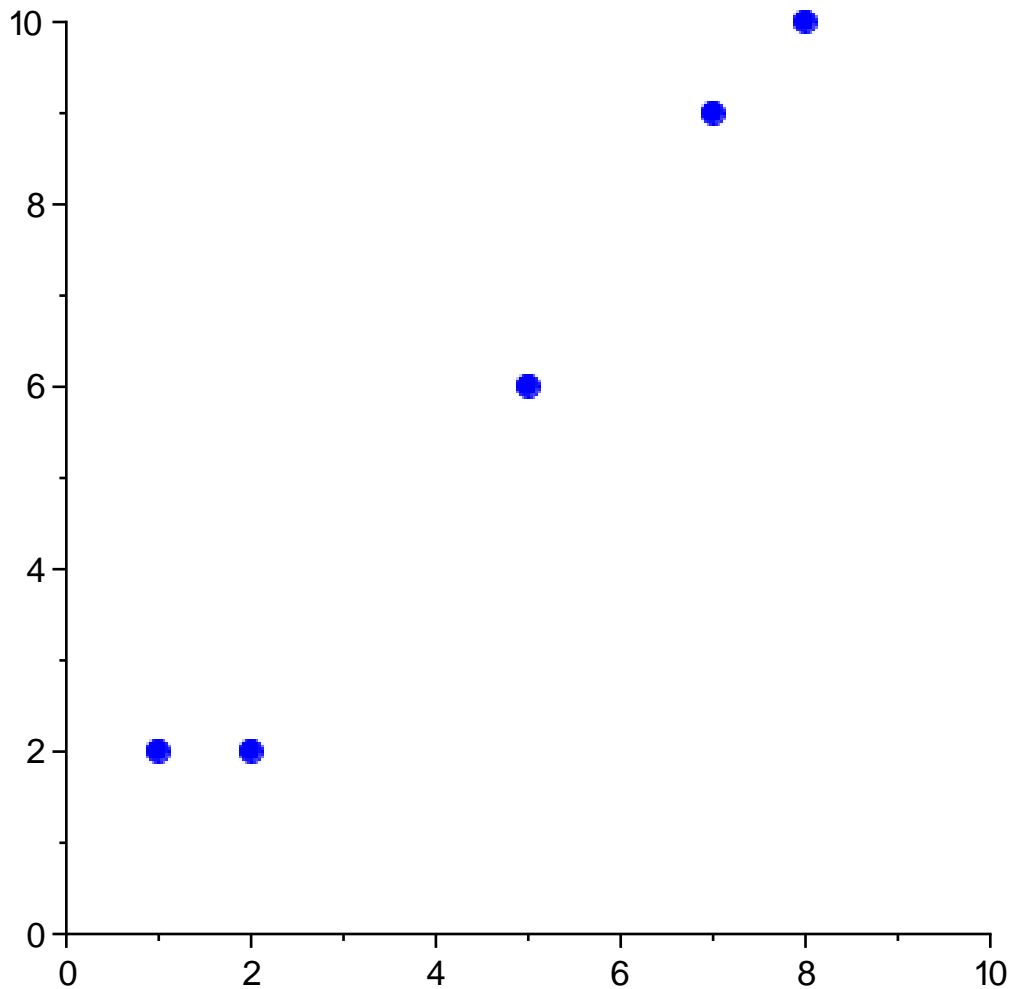
```
> data := [[1,2], [2,2], [5,6], [7,9], [8,10]];
```

```
data := [[1, 2], [2, 2], [5, 6], [7, 9], [8, 10]]
```

(1)

```
> setoptions(symbol=solidcircle,symbolsize=18,color=blue,thickness=4);
```

```
> plot(data,style=point,view=[0..10,0..10]);
```



```
> err := (f,pt) -> abs(f(pt[1]) - pt[2]);
```

```
err := (f,pt) -> |f(pt1) - pt2|
```

(2)

```
> err(sin, [0, -.2]);
```

```
0.2
```

(3)

```
> err(x^2, [0, -.2]);
```

```
|x(0)2 + 0.2|
```

(4)

```
> f := x -> x^2;
```

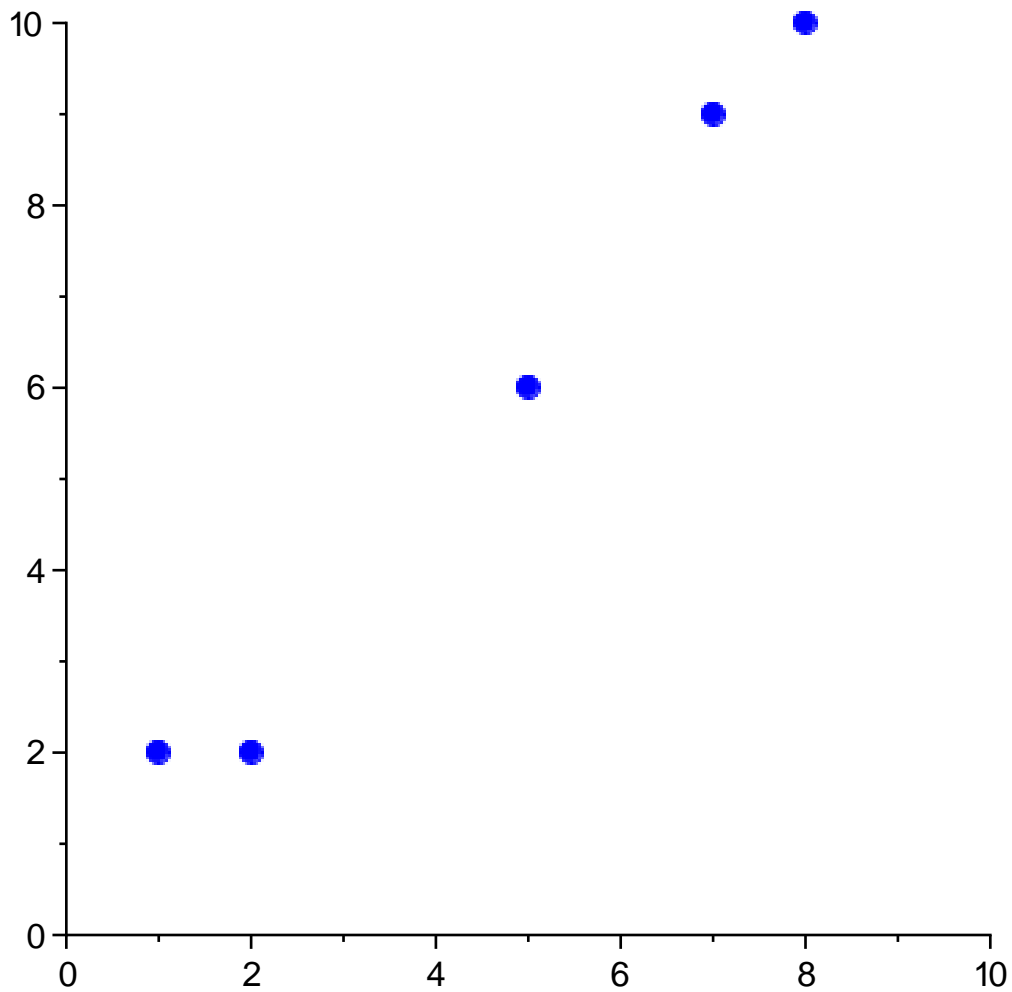
```
f := x -> x2
```

(5)

```

> err(f, [0, -2]);
2 (6)
> err(x->x^2+1, [0, -2]);
3 (7)
> data[1];
[1, 2] (8)
> data[2];
[2, 2] (9)
> err(x->x+1,data[1]);
0 (10)
> err(x->x+1,data[2]);
1 (11)
> seq( err(x->x+1, data[i]), i=1..5);
0, 1, 0, 1, 1 (12)
> seq( err(x->3*x+1.5, data[i]), i=1..5);
2.5, 5.5, 10.5, 13.5, 15.5 (13)
> data;
[[1, 2], [2, 2], [5, 6], [7, 9], [8, 10]] (14)
> op(data);
[1, 2], [2, 2], [5, 6], [7, 9], [8, 10] (15)
> nops(data);
5 (16)
> nops({1, 3, 5, 89, shoe, rabbit, hat});
7 (17)
> sum( err(x->3*x+1.5, data[i]), i=1..nops(data))/
nops(data);
9.500000000 (18)
> linus:= (m,b) -> (x->m*x + b);
linus := (m, b) -> x -> m*x + b (19)
> linus(3,4);
x -> 3x + 4 (20)
> linus(3,4)(2);
10 (21)
> plot(data,style=point,view=[0..10,0..10]);

```



```
> sum( err(linus(1,1), data[i]), i=1..nops(data))/
nops(data);
```

$$\frac{3}{5}$$

(22)

```
> dist := (f, data) ->
sum( err(f, data[i]), i=1..nops(data))/ nops(data);
```

$$dist := (f, data) \rightarrow \frac{\sum_{i=1}^{nops(data)} err(f, data_i)}{nops(data)}$$

(23)

```
> dist(linus(1,1.0),data);
```

0.6000000000

(24)

```
> dist(linus(1,0.9),data);
```

0.6600000000

(25)

```
> dist(linus(1,1.1),data);
```

0.6200000000

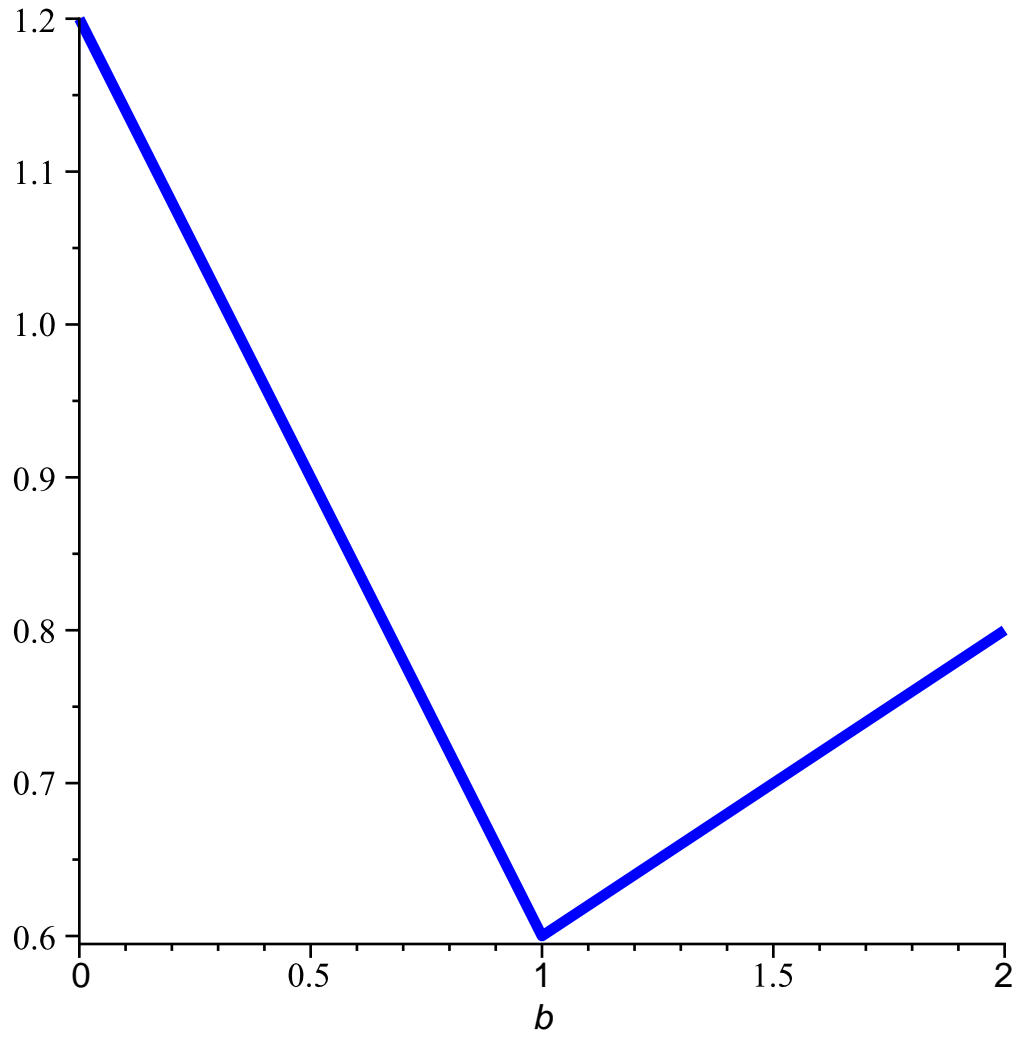
(26)

```
> dist(linus(1,b),data);
```

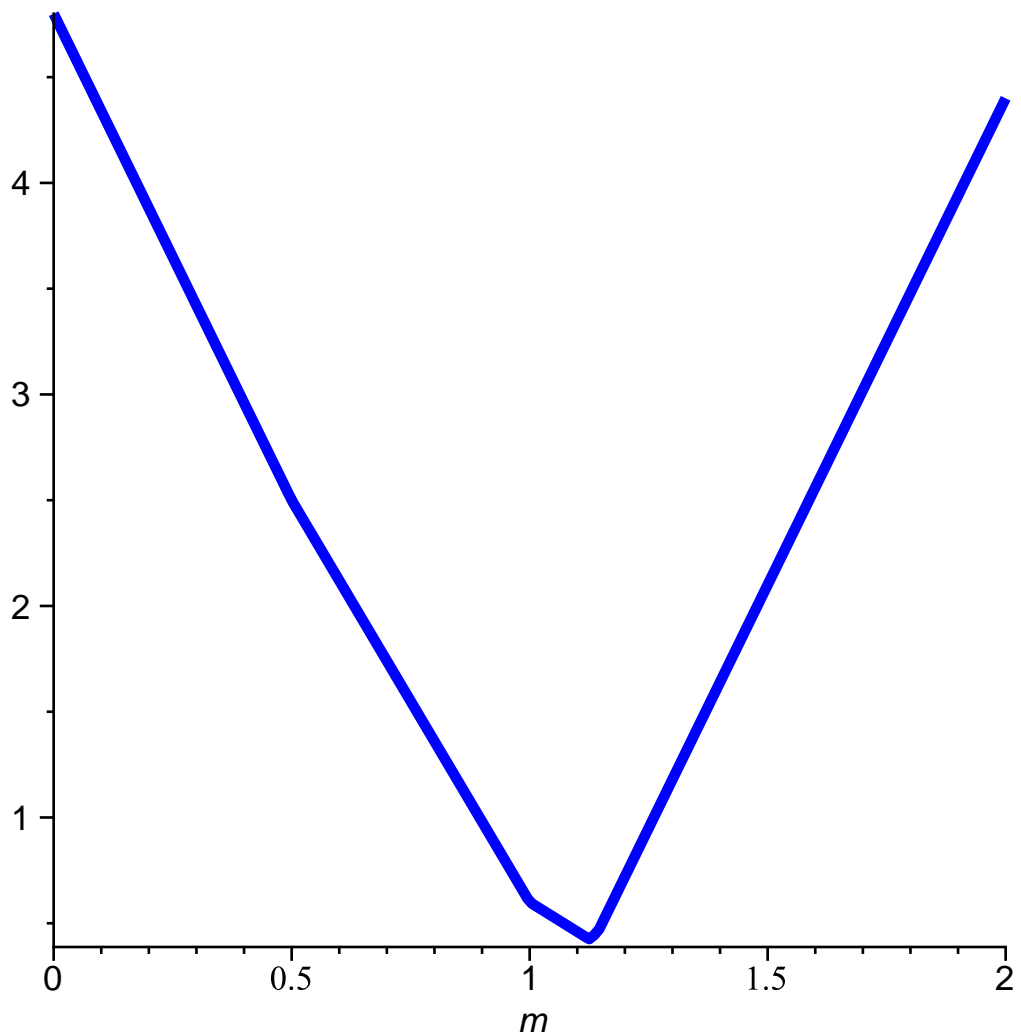
$$\frac{2}{5} |-1 + b| + \frac{1}{5} |b| + \frac{2}{5} |-2 + b|$$

(27)

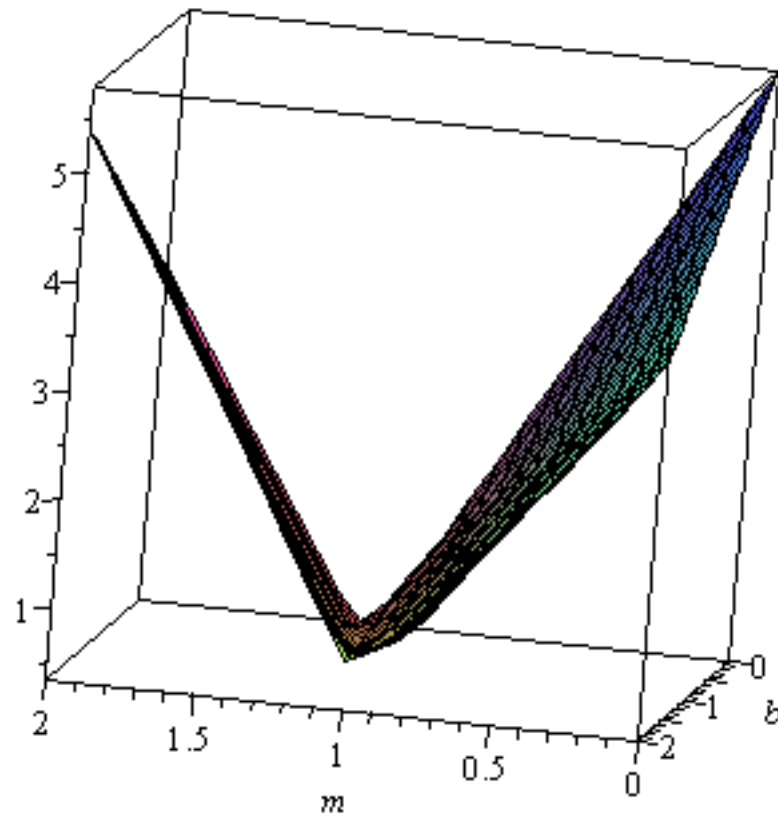
```
> plot(dist(linus(1,b),data), b=0..2);
```



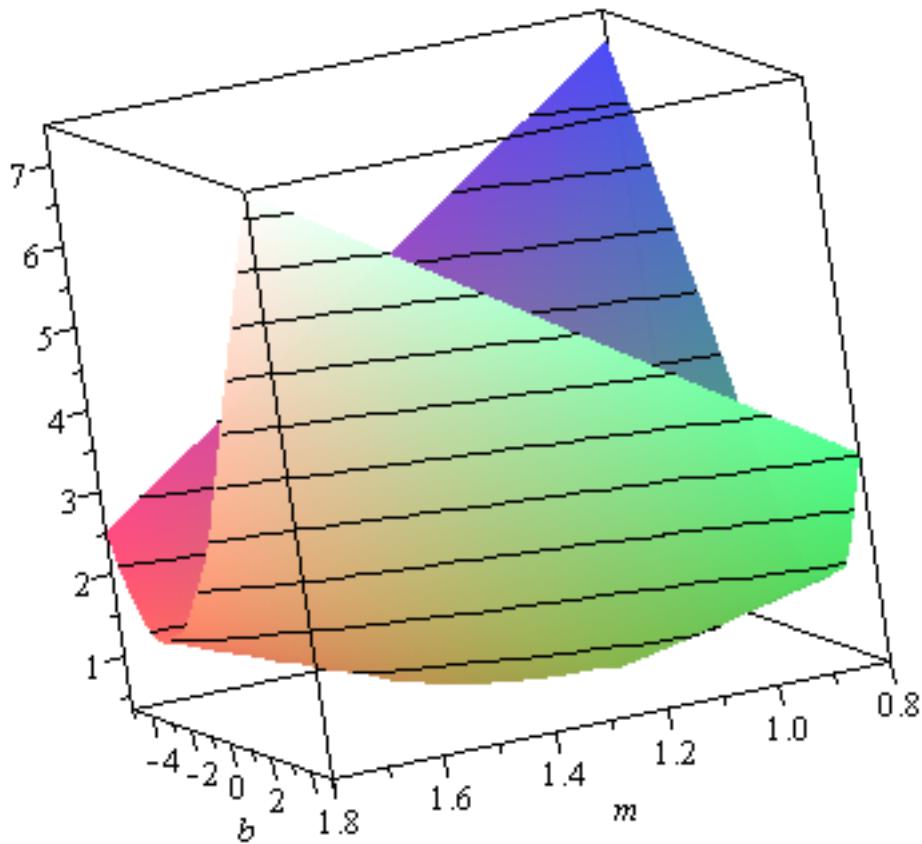
```
> plot(dist(linus(m,1),data), m=0..2);
```



```
> plot3d(dist(linus(m,b),data), m=0..2, b=0..2, axes=boxed);
```



```
> plot3d(dist(linus(m,b),data), m=0.8..1.8, b=-5..5, axes=boxed,  
style=patchcontour);
```



```
> dist(linus(m,b),data);
```

$$\frac{1}{5} |m + b - 2| + \frac{1}{5} |2m + b - 2| + \frac{1}{5} |5m + b - 6| + \frac{1}{5} |7m + b - 9| + \frac{1}{5} |8m + b - 10| \quad (28)$$

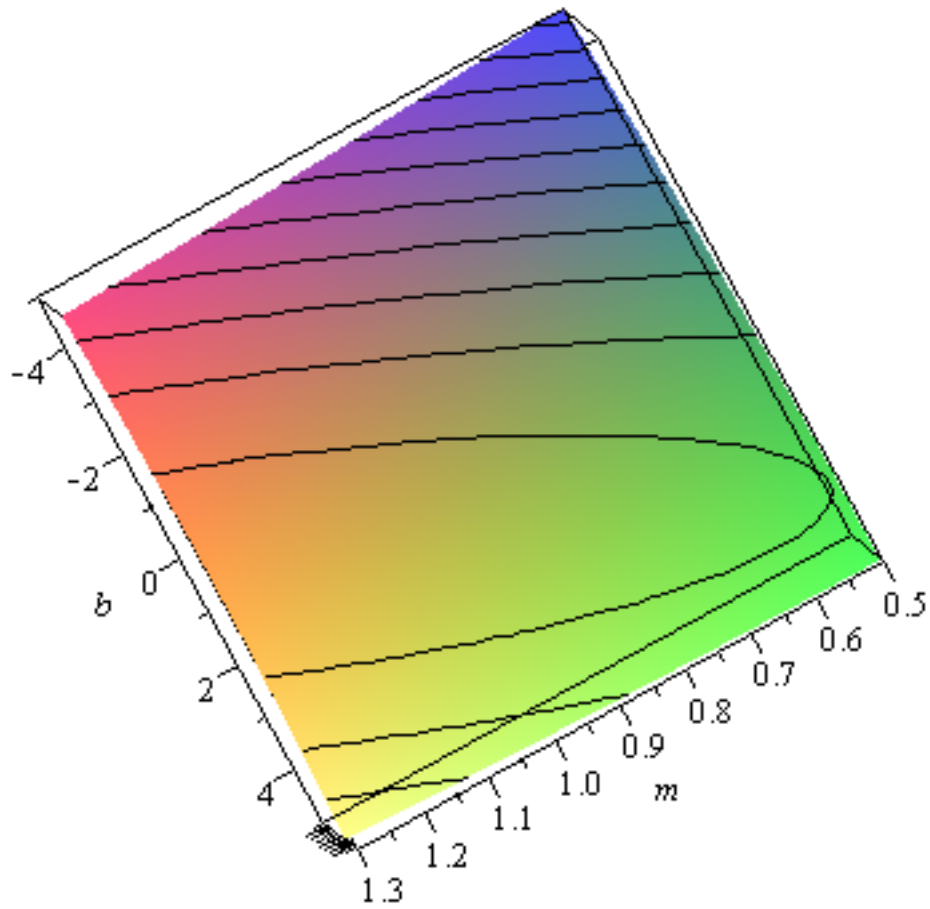
```
> err := (f,pt) -> (f(pt[1]) - pt[2])^2;
```

$$err := (f, pt) \rightarrow (f(pt_1) - pt_2)^2 \quad (29)$$

```
> dist(linus(m,b),data);
```

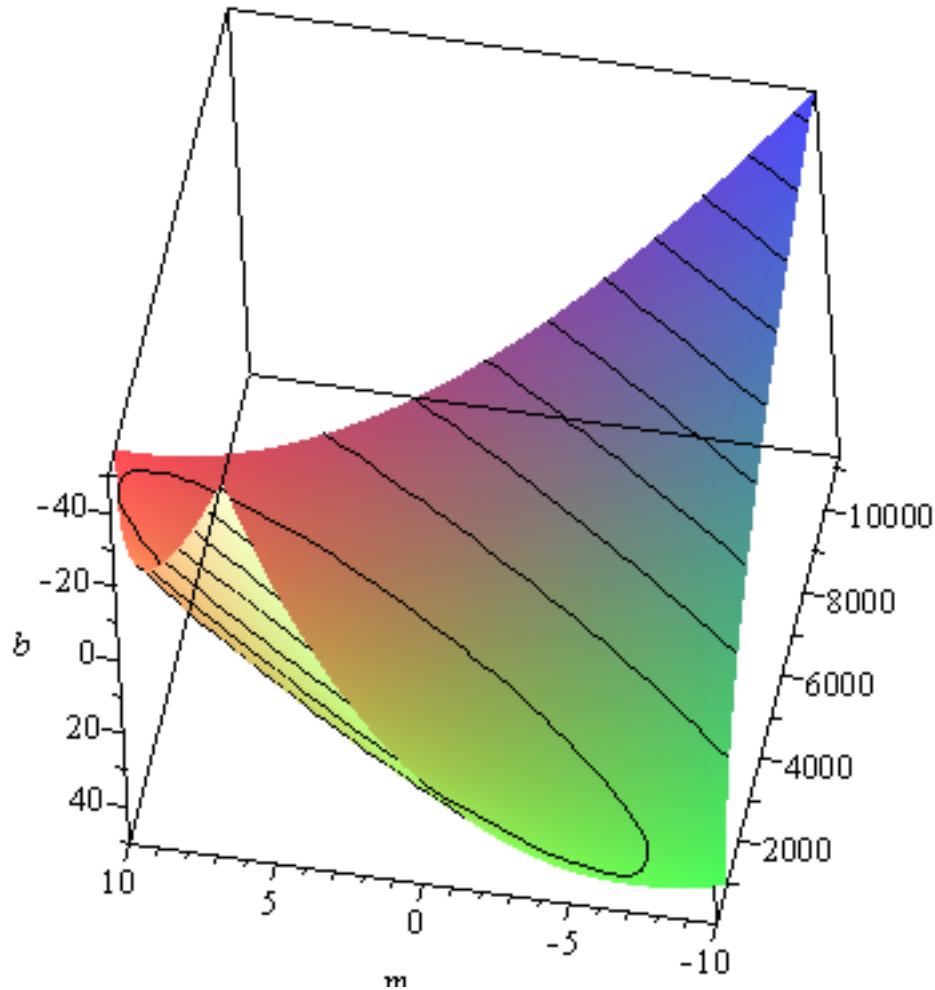
$$\frac{1}{5} (m + b - 2)^2 + \frac{1}{5} (2m + b - 2)^2 + \frac{1}{5} (5m + b - 6)^2 + \frac{1}{5} (7m + b - 9)^2 + \frac{1}{5} (8m + b - 10)^2 \quad (30)$$

```
> plot3d(dist(linus(m,b),data), m=0.5..1.3, b=-5..5, axes=boxed, style=patchcontour);
```



```
> plot3d(dist(linus(m,b),data), m=-10..10, b=-50..50, axes=boxed,  
style=patchcontour);
```





```
> diff(dist(linus(m,b),data),m);
```

$$\frac{286}{5} m + \frac{46}{5} b - \frac{358}{5} \quad (31)$$

```
> diff(dist(linus(m,b),data),b);
```

$$\frac{46}{5} m + 2 b - \frac{58}{5} \quad (32)$$

```
> solve({diff(dist(linus(m,b),data),m)=0,
diff(dist(linus(m,b),data),b)=0}, {m,b});
```

$$\left\{ b = \frac{5}{31}, m = \frac{38}{31} \right\} \quad (33)$$

```
> with(CurveFitting):
```

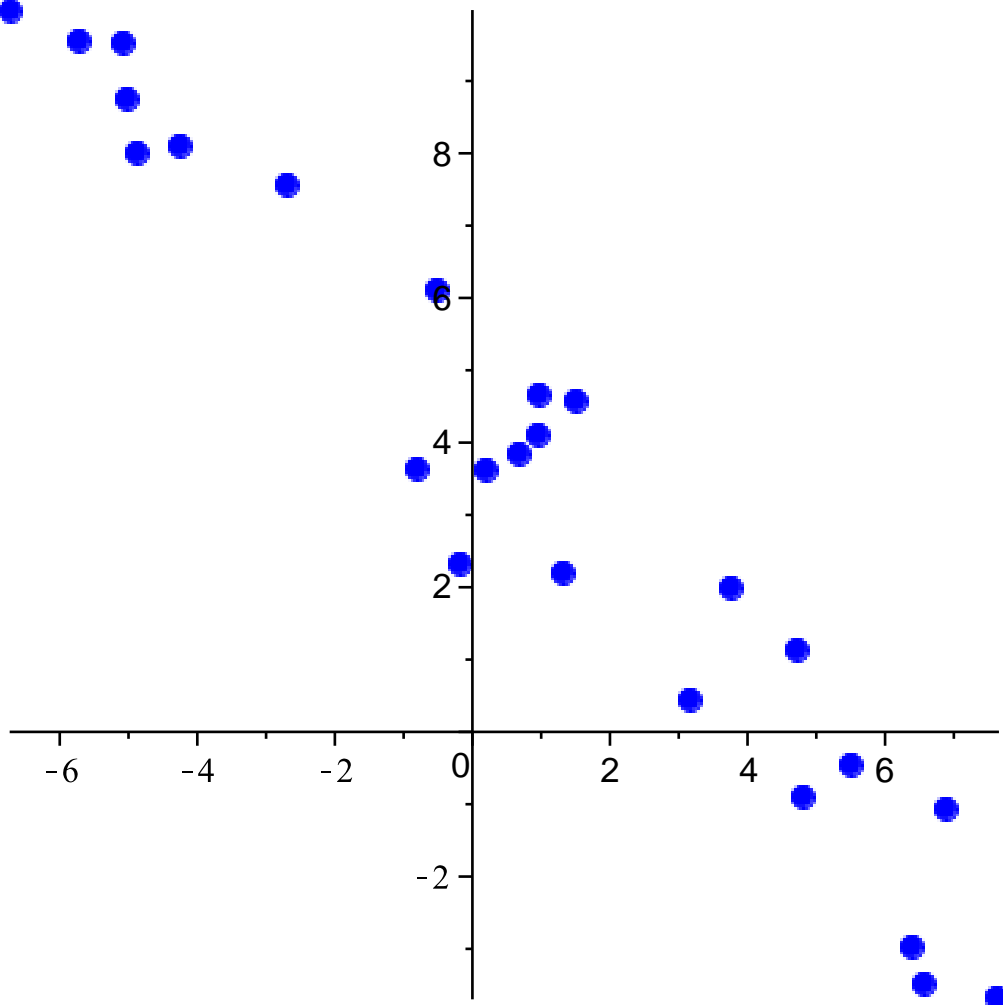
```
> LeastSquares(data,x);
```

$$\frac{5}{31} + \frac{38}{31} x \quad (34)$$

```
> moredata:=[[6.399555221, -2.975032259], [.972268069,
4.644979231], [-.174930733,2.313538498], [-5.073540384,
9.514984401], [6.893861527, -1.071097006], [1.510235158,
4.569017281], [.955599370, 4.097468044], [-5.712634201,
9.544519402],[.691425053, 3.830846574], [-6.708865618,
9.962202300], [3.761176009, 1.978739404], [3.172070319,
```

```
.432025264], [-2.684165704, 7.561362842], [-4.250626903,
8.100249035], [.201116234, 3.609631780], [5.514142588,
-.466174813], [4.722721945, 1.119994312], [7.636264182,
-3.679228223], [-4.873069134, 7.999031928], [-5.019405423,
8.742503689], [4.811048112, -.901298665], [-.504420785,
6.102454305], [6.576501459, -3.495854902], [-.796916715,
3.623549343], [1.325774350, 2.186174499]]:
```

```
> plot(moredata,style=point);
```



```
> LeastSquares(moredata,x);
```

```
4.21682866691290 - 0.934399508040875 x
```

(35)

```
> solve({diff(dist(linus(m,b),moredata),m)=0,
diff(dist(linus(m,b),moredata),b)=0}, {m,b});
```

```
{b = 4.216828665, m = -0.9343995079}
```

(36)

```
> subs(%,m*x+b);
```

```
-0.9343995079 x + 4.216828665
```

(37)

```
> mylsq:=data ->
```

```
subs(
```

```
solve({diff(dist(linus(m,b),data),m)=0,
```

```
diff(dist(linus(m,b),data),b)=0}, {m,b}),
```

```
m*x+b):
```

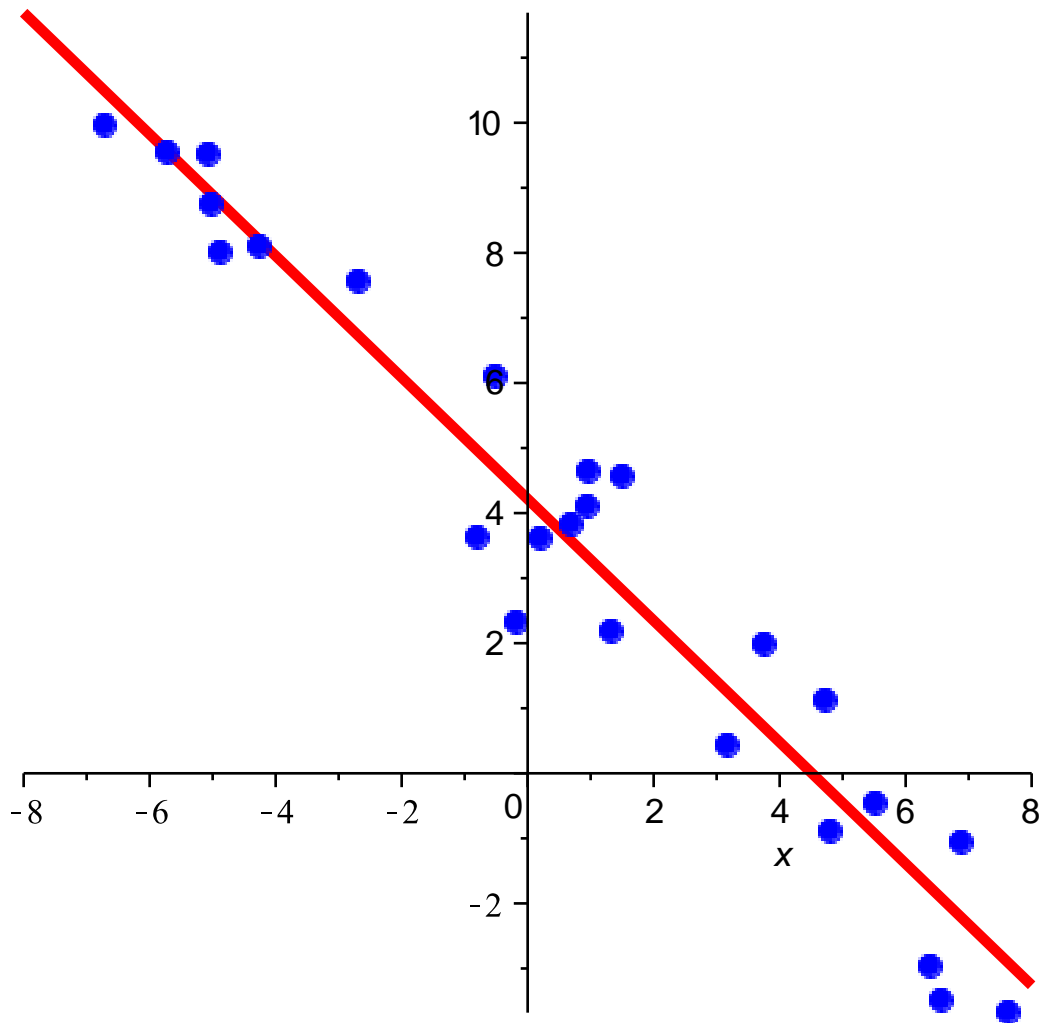
```
> mylsq(data);
```

$$\frac{5}{31} + \frac{38}{31} x \quad (38)$$

```
> mylsq(moredata);
```

$$-0.9343995079 x + 4.216828665 \quad (39)$$

```
> display( {plot(moredata,style=point),  
plot(mylsq(moredata),x=-8..8, color=red)});
```



```
> g:=(a,b,c)->dist(x->a*x^2+b*x+c, data);
```

$$g := (a, b, c) \rightarrow \text{dist}(x \rightarrow a * x^2 + b * x + c, \text{data}) \quad (40)$$

```
> diff(g(a,b,c),a);data;
```

$$\frac{14278}{5} a + \frac{1978}{5} b + \frac{286}{5} c - \frac{2482}{5} \quad (41)$$

[[1, 2], [2, 2], [5, 6], [7, 9], [8, 10]]

```
> solve({ diff(g(a,b,c),a)=0, diff(g(a,b,c),b)=0,  
diff(g(a,b,c),c)=0}, {a,b,c});
```

$$\left\{ a = \frac{29}{519}, b = \frac{126}{173}, c = \frac{442}{519} \right\} \quad (42)$$

```
> h:= subs(%, a*x^2+b*x+c);
```

(43)

$$h := \frac{29}{519} x^2 + \frac{126}{173} x + \frac{442}{519}$$

(43)

```
> display( {plot(data,style=point),  
            plot(h,x=0..9, color=red)});
```

