

EBA 2911, lecture 7, 23 Sept. 2020, Runar Ike

- Plan
1. Functions and graphs
 2. Linear functions and straight lines
 3. Quadratic functions and parabolas
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1. Functions and graphs

Ex Empirical functions

- the temperature is a function of time
- fertility
- the price of salmon
- all kinds of 'indexes'

A function is a table of function values

x	...
f(x)	...

Ex $f(x)$ = average age at first child birth
in year x

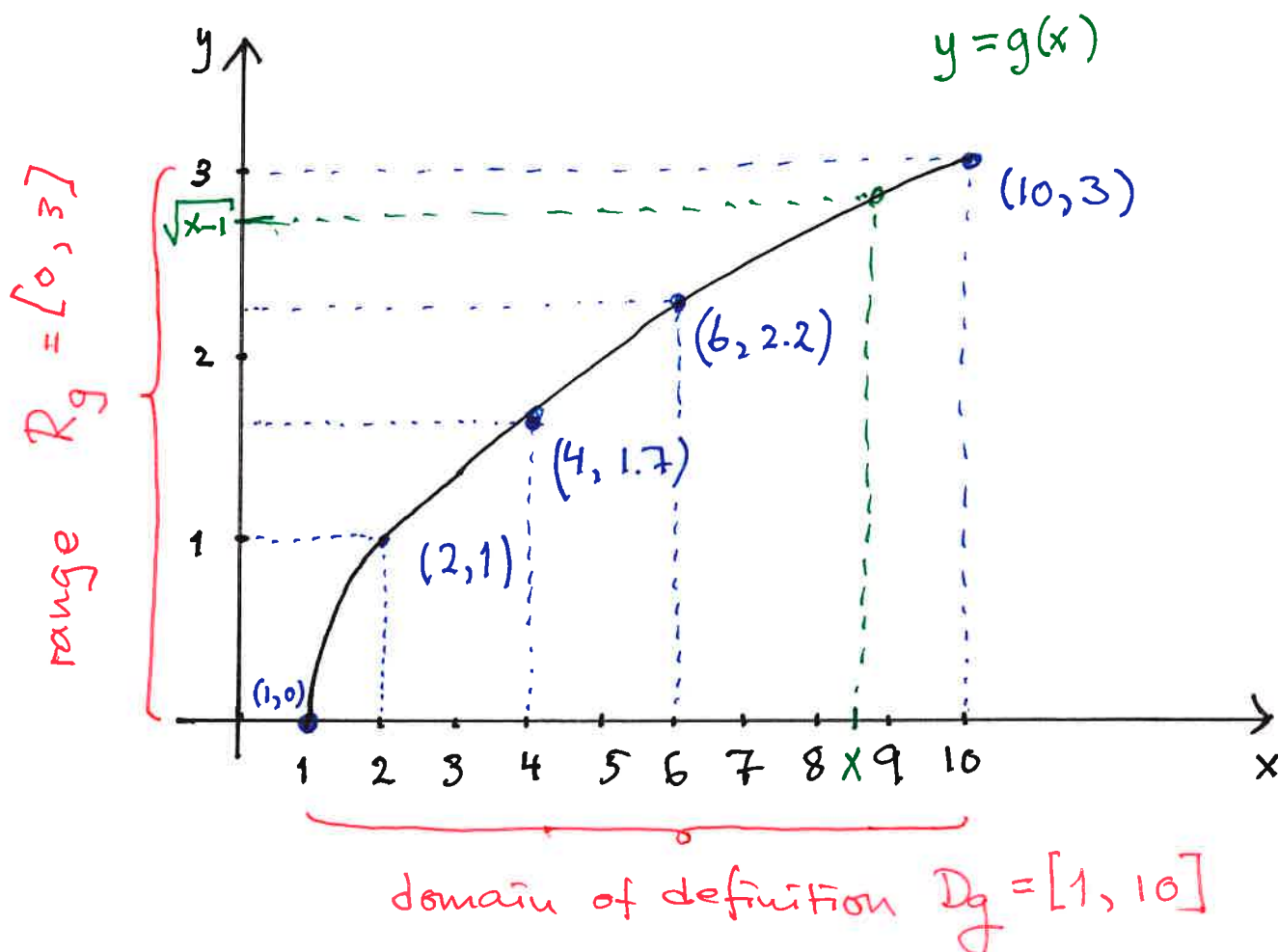
Domain of definition $x \in [1961, 2018]$
= D_f

Ex $g(x) = \sqrt{x-1}$. The largest possible
domain of definition is $D_g = [1, \infty)$

want to draw the graph with
 $D_g = [1, 10]$.

1. make a table of function values.

x	1	2	4	6	10
$g(x)$	0	1	1.7	2.2	3



2. Linear functions $f(x) = ax + b$

- the graph is a line.

The point-slope formula

If (x_0, y_0) is a point on the graph and a is the slope, then

$$y - y_0 = a \cdot (x - x_0)$$

Ex If $(x_0, y_0) = (9, 25)$

$(x_1, y_1) = (11, 31)$ are

two points on the line, then the slope is

$$a = \frac{31 - 25}{11 - 9} = \frac{6}{2} = 3$$

The point-slope formula gives

$$y - 25 = 3 \cdot (x - 9)$$

$$\text{so } y = 3x - 27 + 25$$

$$\underline{\underline{y = 3x - 2}}$$

Problem The graph of a linear function $f(x)$ passes through the points $(20, 46)$ and $(170, 16)$.

- Calculate the slope of the line
- Determine the expression for $f(x)$
- Determine the intersection points of the line with the x -axis and the y -axis.

Solution a) the slope: $\frac{16 - 46}{170 - 20} = \frac{-30}{150} = \underline{\underline{-0.2}}$

b) the point-slope formula with $(20, 46)$ gives

$$y - 46 = -0.2 \cdot (x - 20)$$

that is $y = -0.2x + 4 + 46 = \underline{\underline{-0.2x + 50}} = f(x)$

c) intersection with y-axis: $(0, f(0)) = \underline{\underline{(0, 50)}}$

intersect with x-axis: $y = 0$ gives the

equation $-0.2x + 50 = 0$

so $-0.2x = -50$

so $x = \frac{-50}{-0.2} = \underline{\underline{250}}$

so the point is $\underline{\underline{(250, 0)}}$

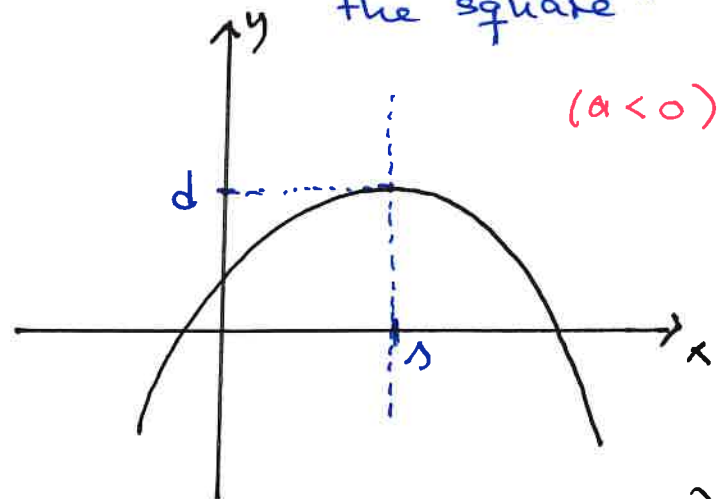
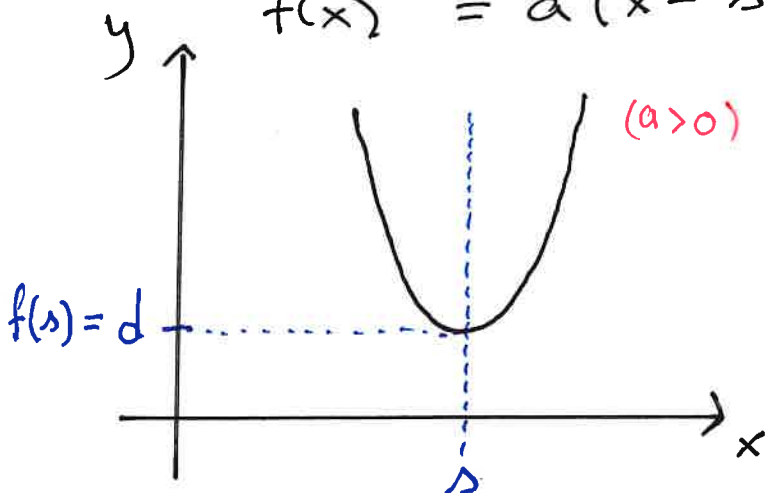
3. Quadratic functions

$$f(x) = ax^2 + bx + c$$

but if we want to draw the graph the following expression is better:

$$f(x) = a(x - s)^2 + d$$

"by completing the square"



Ex $f(x) = x^2 - 2x + 3$

$$= (x-1)^2 + 2 \quad (\text{so } a=1, s=1, d=2)$$

Problem Suppose the quadratic function $f(x)$ has the minimum value $y = -1$ and symmetry the line $x = 5$ and the graph passes through the point $(9, 3)$.

- a) Determine the expression $f(x) = a(x-s)^2 + d$
b) Determine where the graph crosses the x -axis and the y -axis.

Solution a) have been given $s = 5$ and $d = -1$

$$\text{so } f(x) = a(x-5)^2 - 1$$

$$\text{then } f(9) = 3 \text{ gives } a(9-5)^2 - 1 = 3$$

$$\text{so } 16a = 4$$

$$a = \frac{1}{4} = 0.25$$

$$\text{and } f(x) = \underline{\underline{0.25 \cdot (x-5)^2 - 1}}$$

b) Crosses the x -axis: solves $f(x) = 0$

$$\text{i.e. } 0.25(x-5)^2 - 1 = 0 \quad | \cdot 4$$

$$(x-5)^2 = 4$$

$$x-5 = \pm 2 \quad \text{so } \underline{\underline{x=3}} \text{ or } \underline{\underline{x=7}}$$

Crosses the y-axis : $y = f(0) = 0.25 \cdot (0-5)^2 - 1$
 $= 0.25 \cdot 25 - 1$
 $= 6.25 - 1$
 $= \underline{\underline{5.25}}$

or as point (0, 5.25)