In physics, as with all sciences, we are concerned with the relationship between observed measurements.

There are two types of correlations **direct** and **indirect**.

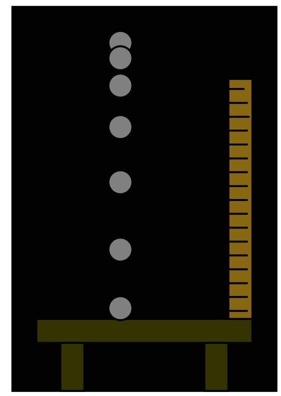
Direct Correlations

These are correlations where as one measured quantity increases, so does the other.

Indirect Correlations

These are correlations where as one measured quantity increases the other decreases.

In science, when collecting data, there are usually two measured quantities. Generally, one measurement is controlled and the other observed. The controlled measurement is called the **independent variable**, the observed measurement is called the **dependent variable.**

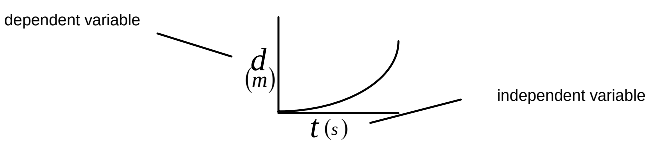


Ex: In an experiment to measure the acceleration due to gravity, you drop a ball and photograph it with a stroboscope camera set-up.

A stroboscope is a device that creates bright flashes as a constant rate. (a.k.a strobe light). The images produced are exposed to film. With this apparatus, the time between each flash is fixed; as a result, each exposure is separated by a precise amount of time.

In this case the time increments are fixed, therefore time is the **independent variable.** The observed distances between exposures would be the **dependent variable** in this case.

If you were to make a graph to represent the data, the x-axis **ALWAYS** represents the independent variable and the y-axis **ALWAYS** represents the dependent variable.



Linear Relationships

Linear relationships are those where the dependent and the independent variables increase at the same rate.

Ex:

d(m)	t(s)
100	2
200	4
300	6
400	8

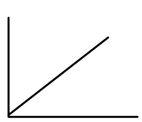
2× 3× 4×

Linear relationships always take the form of a straight line when represents graphically.

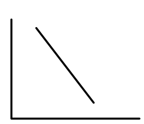
Sample

A	B
5	3
10	6
15	9
20	12
25	?
30	?

Note: Linear relationships can be both direct and indirect relationships.



Direct: slopes up and to the right



Indirect: slopes down and to the right

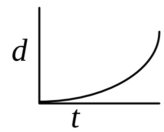
Non-Linear Relationship

Non-linear relationships are those where the dependent and independent variables are related by an exponential relationship.

Quadratic relationship (squared)

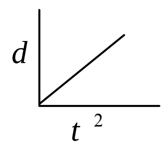
Where the **dependent variable** is directly related to the **square** of the **independent variab**le.

	d	t	
	1	1	
4×	4	2	2×
9×	9	3	3×
16×	16	4	4×



Now compare $d\ vs.t^2$

d	t	t^2
1	1	1
4	2	4
9	3	9
16	4	16



$\therefore d \propto t^2$

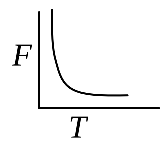
Example: Find the relationship.

A	B
5	1
20	2
80	4
180	6
320	8

The inverse relationship

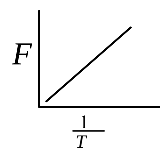
Where the **dependent variable** is directly related to the **inverse** of the **independent variable**.

	F	T	
	100	0.01	
$2\times$	200	0.005	$\frac{1}{2}\times$
$4\times$	400	0.0025	$\frac{1}{4}\times$
$5\times$	500	0.002	$\frac{1}{5}\times$



Now compare $F\ vs. \frac{1}{T}$

F	T	$\frac{1}{T}$
100	0.01	100
200	0.005	200
400	0.0025	400
500	0.002	500

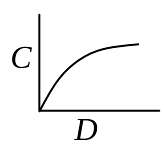


$\therefore F \propto \frac{1}{T}$

The square root relationship

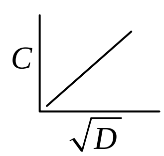
Where the **dependent variable** is directly related to the **square root** of the **independent variable**.

	C	D	
	1	4	
$2\times$	2	16	$4\times$
$3\times$	3	36	$9\times$
$3.5\times$	3.5	49	$12.25\times$



Now compare $C\ vs. \sqrt{D}$

	C	D	$\sqrt{D}$	
	1	4	2	
$2\times$	2	16	4	$2\times$
$3\times$	3	36	6	$3\times$
$3.5\times$	3.5	49	7	$3.5\times$

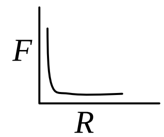


$\therefore C \propto \sqrt{D}$

The inverse square relationship

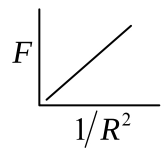
Where the **dependent variable** is directly related to the **inverse square** of the **independent variable**.

F	R
2	1
8	$\frac{1}{2}$
32	$\frac{1}{4}$
72	$\frac{1}{6}$



Now compare $F\ vs. \frac{1}{R^2}$

F	R	$\frac{1}{R^2}$
2	1	1
8	$\frac{1}{2}$	4
32	$\frac{1}{4}$	16
72	$\frac{1}{6}$	36



$$\therefore F \propto \frac{1}{R^2}$$