## Distance form of a line

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The equation of the straight line passing through ( $\mathrm{x} 1, \mathrm{y} 1 \neg$ ) and making an
angle ? with the positive direction of $x-$ axis is
$\mathrm{x}-\mathrm{x} 1=\mathrm{y}-\mathrm{y} 1=\mathrm{r}$
$\cos$ ? $\sin$ ?
where $r$ is the distance of the point $(x, y)$ on the line from the point $(x 1, y 1)$
Proof: Let the given line meets x - axis at $\mathrm{T}, \mathrm{y}$ - axis at V and passes through the point $\mathrm{A}(\mathrm{x} 1, \mathrm{y} 1)$. Let $\mathrm{P}(\mathrm{x}, \mathrm{y})$ be any point on the line at a distance $r$ from $Q(x 1, y 1)$ i. e. $P A=r$.

Draw PM perpendicular to OX, AN perpendicular to OX and AL perpendicular to PM. Then,
$\mathrm{AL}=\mathrm{NM}=\mathrm{OM}-\mathrm{ON}=\mathrm{x}-\mathrm{x} 1$
and, $\mathrm{PL}=\mathrm{PM}-\mathrm{LM}=\mathrm{PM}-\mathrm{AN}=\mathrm{y}-\mathrm{y} 1$
In ?PAL, we have
$\cos ?=\mathrm{AL} / \mathrm{PA}$
$\cos ?=(\mathrm{x}-\mathrm{x} 1) / \mathrm{r}-(\mathrm{i})$
and $\sin ?=\mathrm{PL} / \mathrm{PA}$
$\sin ?=(\mathrm{y}-\mathrm{y} 1) / \mathrm{r}-(\mathrm{ii})$
From (i) and (ii), we get
$x-x 1=y-y 1=r$
$\cos$ ? $\sin$ ?
This is the required equation of the line in the distance form.

## Important Remarks

1. The equation of the line is
```
x-x1 = y - y1 = r
cos? sin?
x - x1 = r cos? and y - y1 = r cos?
x=x1+r\operatorname{cos? and y = y1 +r cos?}
```

Thus, the coordinates of any point on the line at a distance $r$ from the given point $(x 1 \neg, y 1)$ are ( $x 1+r \cos ?, y 1+r \sin$ ?). If $P$ is on the right side of ( $\mathrm{x} 1, \mathrm{y} 1$ ), then r is positive and if P is on the left side of $(\mathrm{x} 1, \mathrm{y} 1)$, then r is negative. Since different values of r determine different points on the line, therefore the above form of the line is also called parametric form or symmetric form of a
line.
2. In the above form one can determine the coordinates of any point on the line at a given distance from the given point through which it passes. At a given distance $r$ from the point $(x 1, y 1)$ on the line $x-x 1=y-y 1$

$$
\cos ? \quad \sin ?
$$

there are two points viz. $(\mathrm{x} 1+\mathrm{r} \cos ?, \mathrm{y} 1+\mathrm{r} \sin$ ?) and ( $\mathrm{x} 1-\mathrm{r} \cos ?, \mathrm{y} 1-\mathrm{r} \sin$ ?)

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## Reference Links :

- http://en.wikipedia.org/wiki/Linear_equation\#Standard_form
- http://en.wikipedia.org/wiki/Distance
- http://en.wikipedia.org/wiki/Perpendicular
- http://www.answers.com/topic/parametric-equation

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