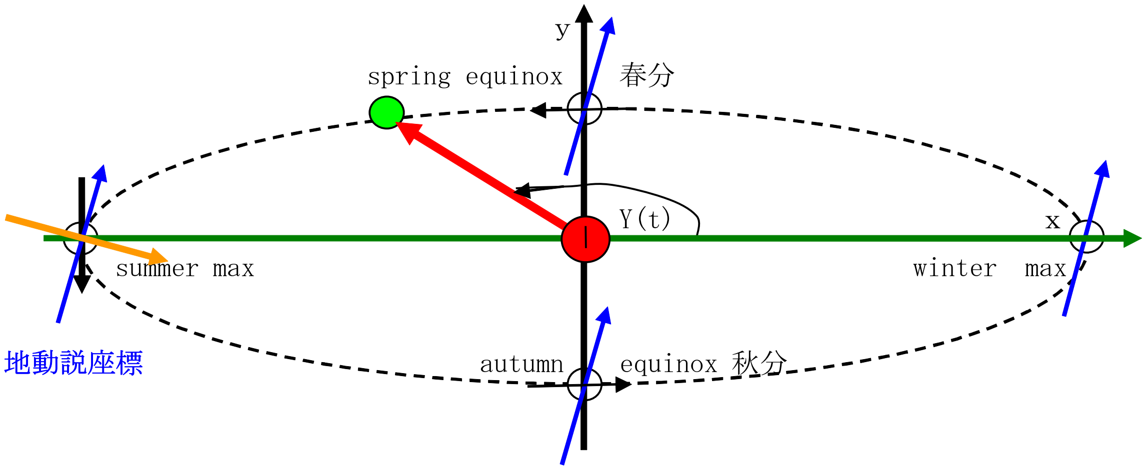
—Insolation Function(latitude Θ ; longitude ϕ, dairy angle ϕ, seasonal angle Y)—

Can you imagine north pole(Θ=90) is hotter than equator(Θ=0)at a season?.

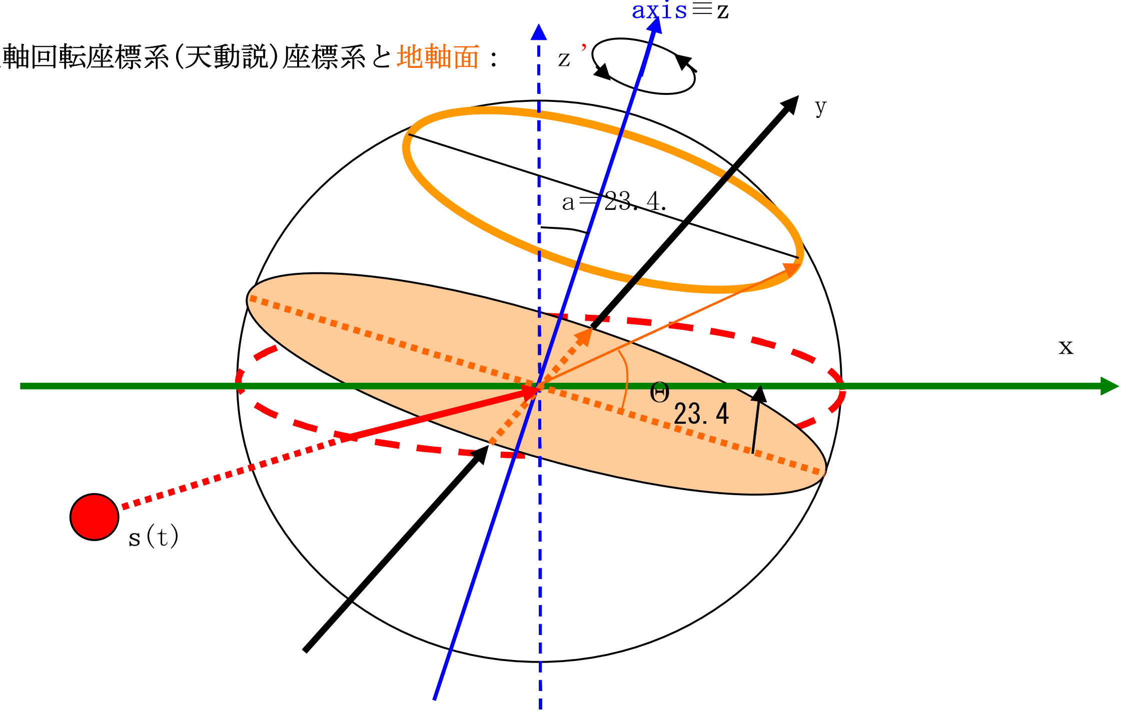
⑴year(seasonal) angle：Y=360t/365. ＜0≦t≦365＞.　　　　　’09/6/13,22,7/6.

Geocentric theory coordinate system(x,y,z) with plane of sun orbit.



⑵geo-axial rotation(geocentric)coordinate system and geo-axial plane:

地軸回転座標系(天動説)座標系と地軸面：



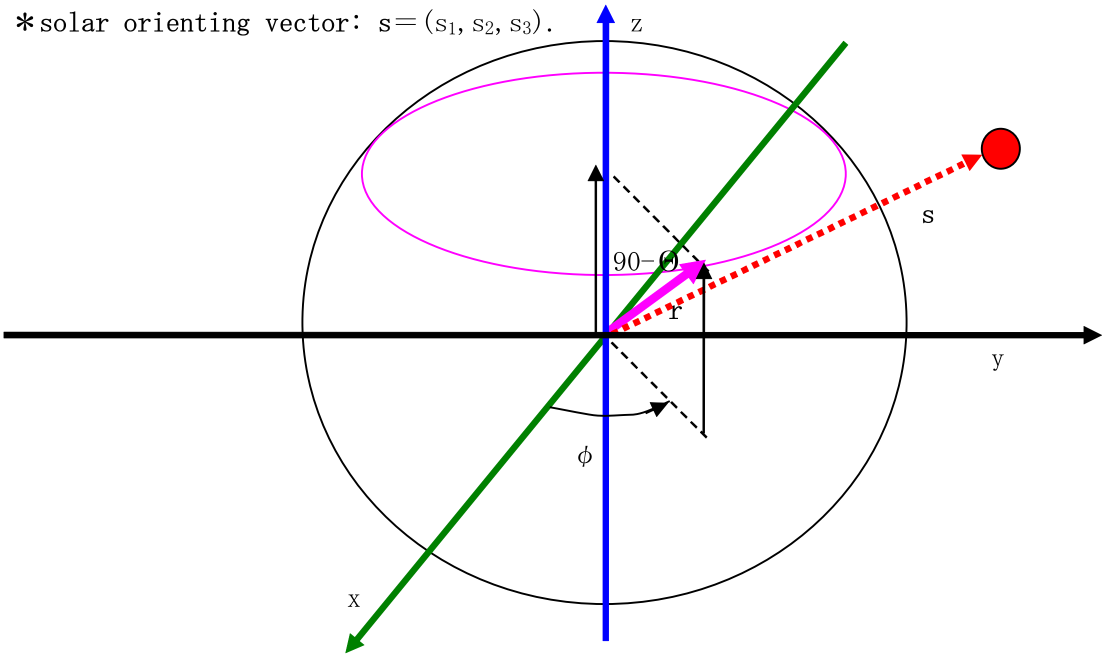
geo-axial plane　plane vector≡z axis≡z, solar orienting vector≡:s(t).

Their inner product relate with seasonal input angle χ(Y(t)) of insolation.

(3)Insolation dependency on angles： $\mathscr{R}=\{(\mathrm{r}\cdot\mathrm{s})+|(\mathrm{r}\cdot\mathrm{s})|\}/2\geqq 0$.

＊position vector on earth: $\mathrm{r}=(\sin\langle 90-\Theta\rangle\cos\phi, \sin\langle 90-\Theta\rangle\sin\phi, \cos\langle 90-\Theta\rangle)$.

＊solar orienting vector: $\mathrm{s}=(s_1, s_2, s_3)$.



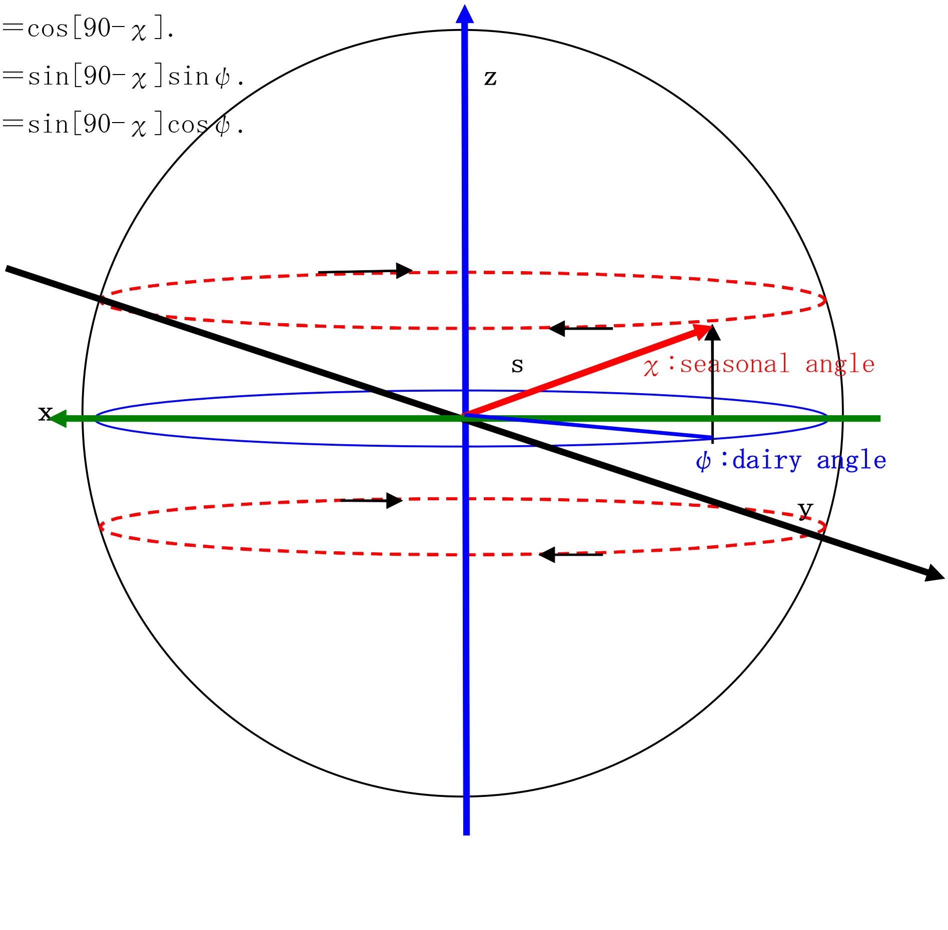
(4)solar orienting vector：$\mathrm{s}=(s_1, s_2, s_3)$ in geocentric coordinate.

$\chi=\chi(Y)$. → seasonal angle of insolation

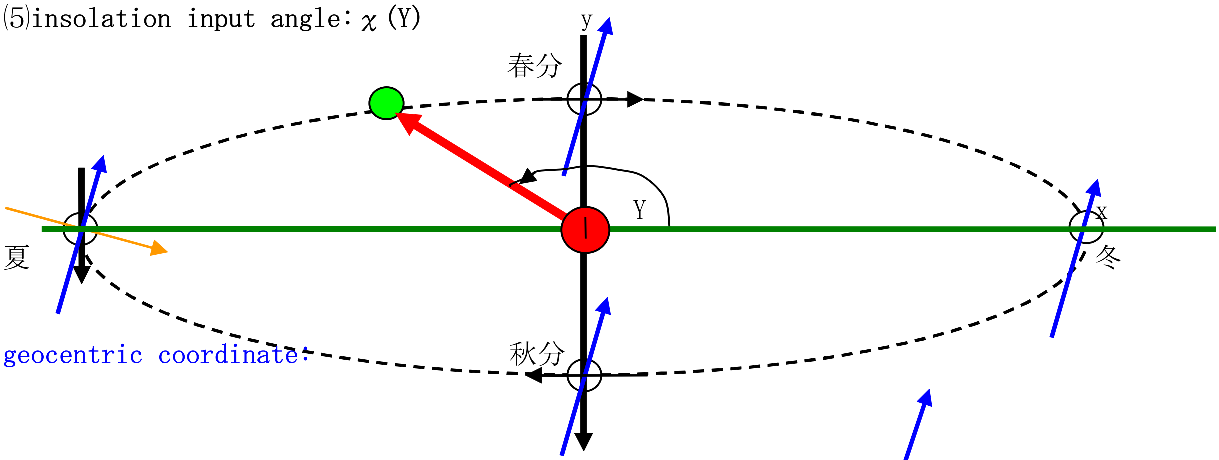
$s_3=\cos[90-\chi]$.

$s_2=\sin[90-\chi]\sin\phi$.

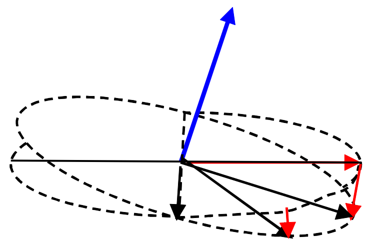
$s_2=\sin[90-\chi]\cos\phi$.



(5)insolation input angle: χ (Y)



geocentric coordinate:



axis : $z=(\sin(23.4), 0, \cos(23.4))$;

red : $s=(-\cos Y, -\sin Y, 0)$。

$\langle z.s\rangle=\sin\chi=-\sin(23.4)\cos Y$。 $Y=360t/365$。

$\chi(t)=-\mathrm{Sin}^{-1}\langle\sin(23.4)\cos(360t/365)\rangle$。 ;degree.
$\chi(t)=-\mathrm{Sin}^{-1}(\sin(0.408)\cos(2*\%pi*t/365))$. ;radian.

(6)Insolation function $\mathscr{R}(t, x; \phi-\phi)$ as the innner product :

$r=(\sin\langle 90-\Theta\rangle\cos\phi, \sin\langle 90-\Theta\rangle\sin\phi, \cos\langle 90-\Theta\rangle)$.

$s=(\sin[90-\chi(t)]\cos\phi(t), \sin[90-\chi(t)]\sin\phi(t), \cos[90-\chi(t)])$.

$|(r\cdot s)|=\sqrt{\langle(r\cdot s)^2\rangle}$. $\rightarrow$ $\mathscr{R}=\{(r\cdot s)+|(r\cdot s)|\}/2$.

$(r\cdot s)=\underline{\sin[90-\chi(t)]\sin\langle 90-\Theta\rangle}\cos\phi(t)\cos\phi$

$+\underline{\sin[90-\chi(t)]\sin\langle 90-\Theta\rangle}\sin\phi(t)\sin\phi+\cos[90-\chi(t)])\cos\langle 90-\Theta\rangle$

$=\langle\sin[90-\chi(t)]\sin\langle 90-\Theta\rangle\langle\cos\phi(t)\cos\phi+\sin\phi(t)\sin\phi\rangle$

$+\cos[90-\chi(t)])\cos\langle 90-\Theta\rangle$

* $R\equiv(r\cdot s)=\sin[\%pi/2-\chi(t)]\sin\langle\%pi/2-\Theta\rangle\underline{\cos[\phi-\phi(t)]}$

$+\cos[\%pi/2-\chi(t)])\cos\langle\%pi/2-\Theta\rangle$.

* $\chi(t)=-\mathrm{Sin}^{-1}(\sin(0.408)\cos(2*\%pi*t/365))$.

Insolation Function{t=365days ; latitude=Θ//longitude=ϕ ;

the seasonal input angle of $\chi(t)$; dairy angle of $\phi(t)$}:

☞:caution:<u>The negative value of R must be zero</u> in $\mathscr{R}=\{(r\cdot s)+|(r\cdot s)|\}/2\geqq 0$.

$\mathscr{R}$ is the actual function of insolation, but R is incomplete one.

(a)Equator： Θ＝0.

R＝(r·s)＝sin[90－ χ (t)]<∫$_{-\pi/2}^{\pi/2}$dtcos[ϕ － ϕ (t)]/2 π >＝sin[90－ χ (t)]/ π

24h dependency/time average

0.318(max)≧R(t)≧0.292(mini).

(b)North Pole： Θ＝90.

R＝ (r・s) ＝cos[90 － χ (t)]). χ ＝-Sin^{-1}<sin(23.4)cos(360t/365) > 0. night sun days(t=0～182.5 日>

0.397(max)≧R(t)≧0.

☞:surprising for us amateurs:

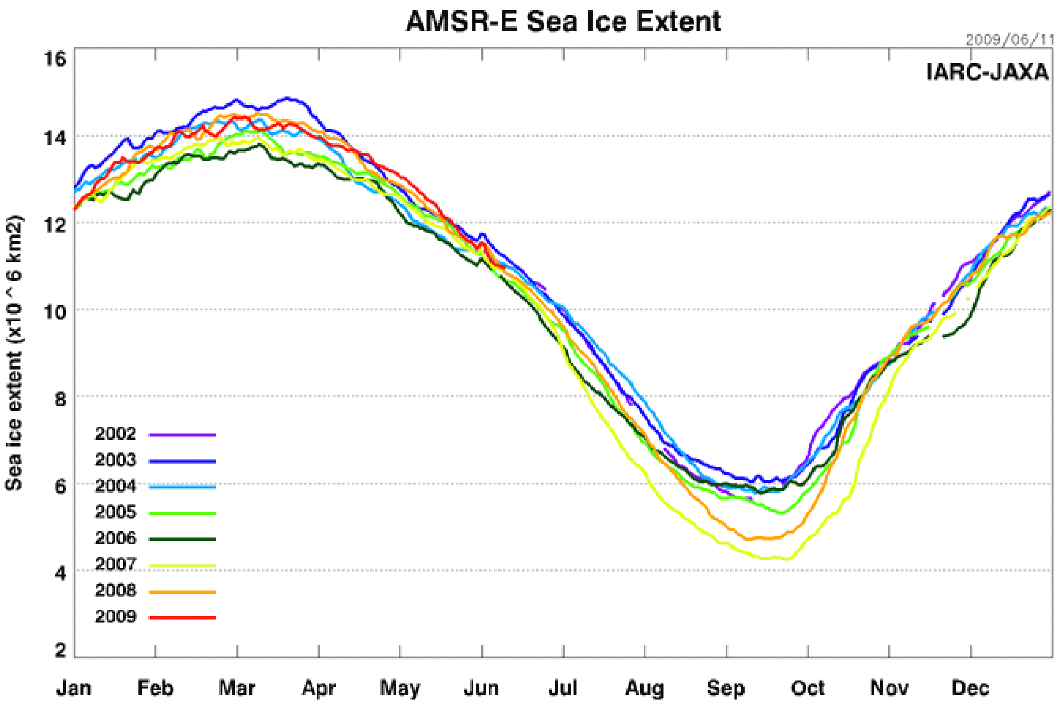
「N P is hotter than Euator in midnight sun days in 24hours total 」.

Consequnetly 2/3 of Arctic ice cover extent can be melted in summer season.

(7)Arctic ice cover extent change in season and years:

http://www.ijis.iarc.uaf.edu/jp/seaice/extent.Htm

Seasonally it oscilate as alternate current componet,while the average direct current component become lower in years trend.



Appendix 1:$\mathscr{R}$(t, x;s= ϕ=0, 3, 6, 9, ... , 21) : Xmaxima graph plotting program format.

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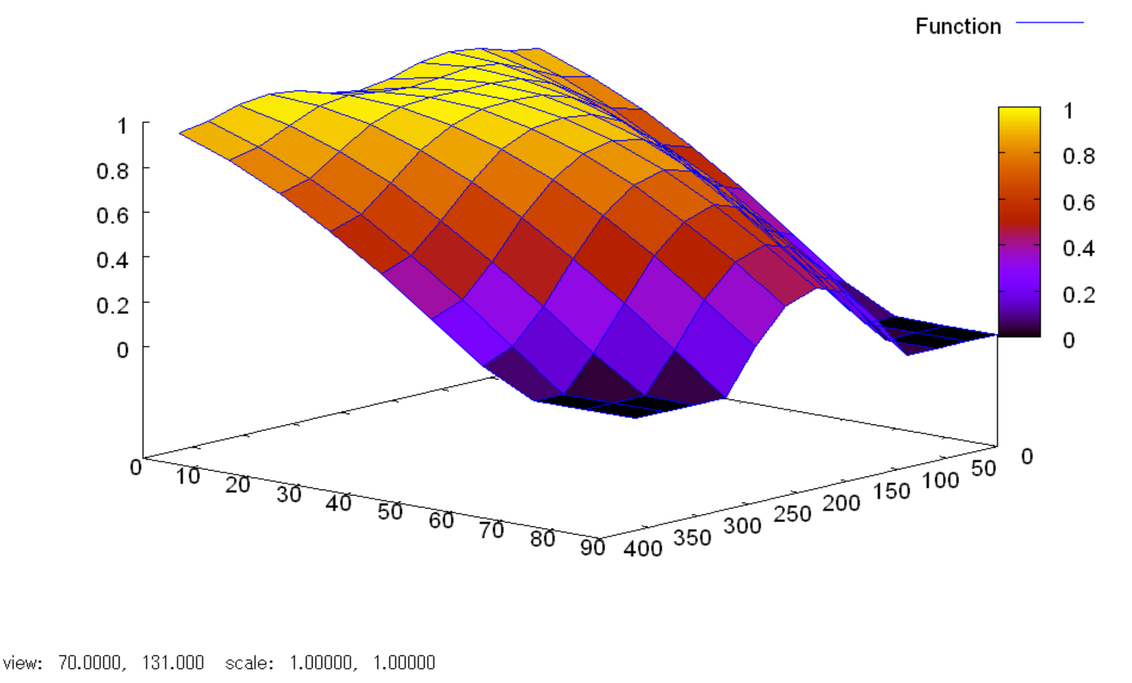
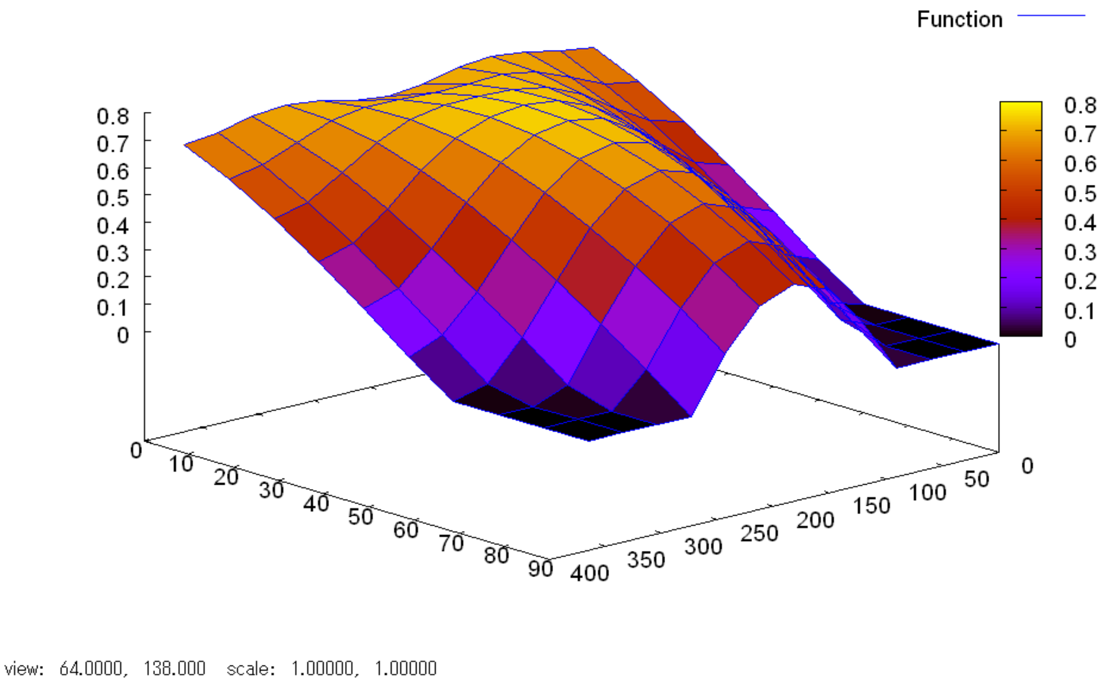
```
plot3d(0.5*abs(sin(%pi/2+asin(sin(0.408)*cos(2*%pi*t/365)))*sin(%pi/2-%pi*x/180)
*cos(2*%pi*s/24)+cos(%pi/2+asin(sin(0.408)*cos(2*%pi*t/365)))
*cos(%pi/2-
%pi*x/180))+0.5*(sin(%pi/2+asin(sin(0.408)*cos(2*%pi*t/365)))*sin(%pi/2-
%pi*x/180)
*cos(2*%pi*s/24)+cos(%pi/2+asin(sin(0.408)*cos(2*%pi*t/365)))
*cos(%pi/2-%pi*x/180)),[t,0,365],[x,0,90],[grid,12,9]);
```

****

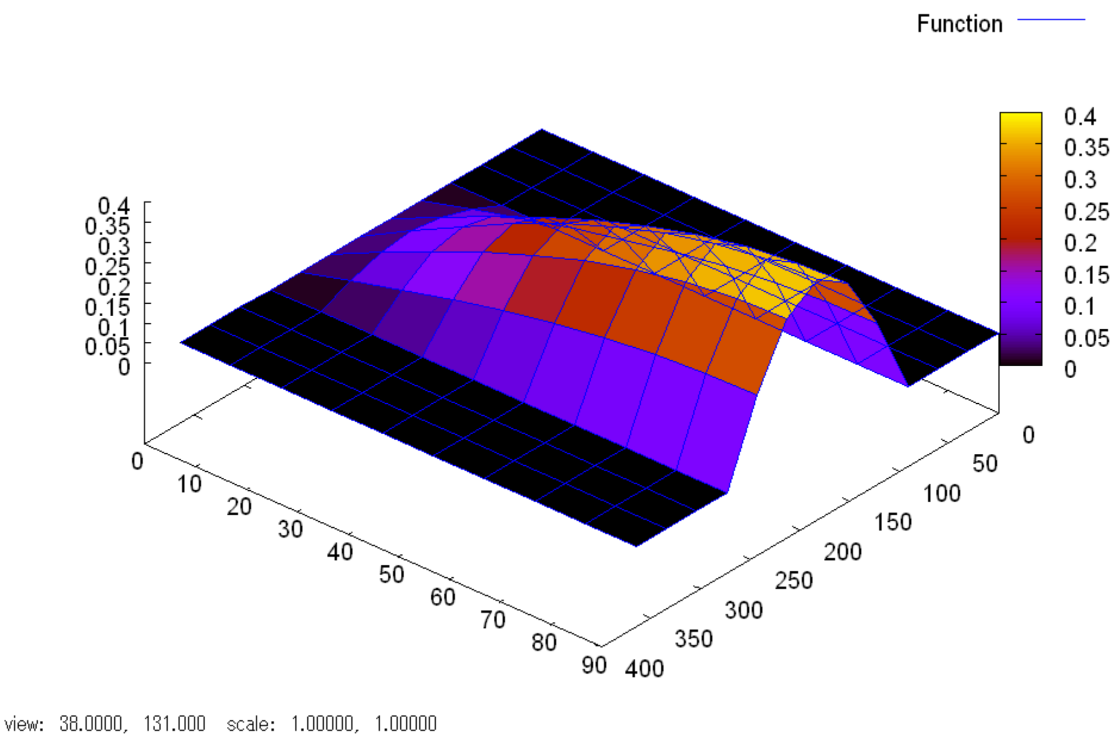
ϕ =0/24.



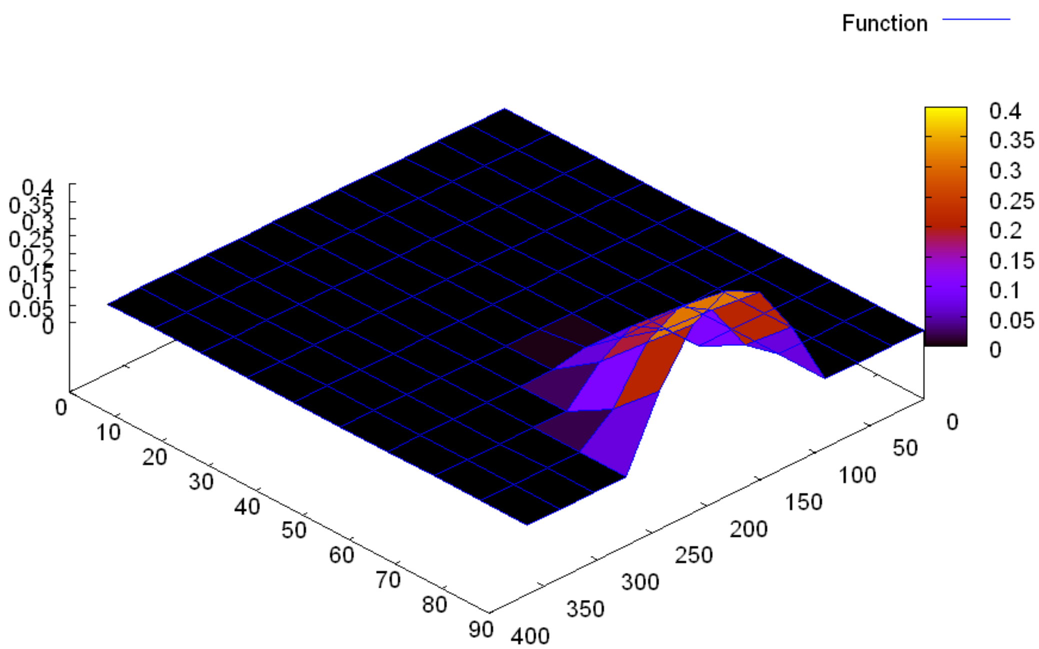
$\phi = 3/24.$



$\phi = 6/24.$

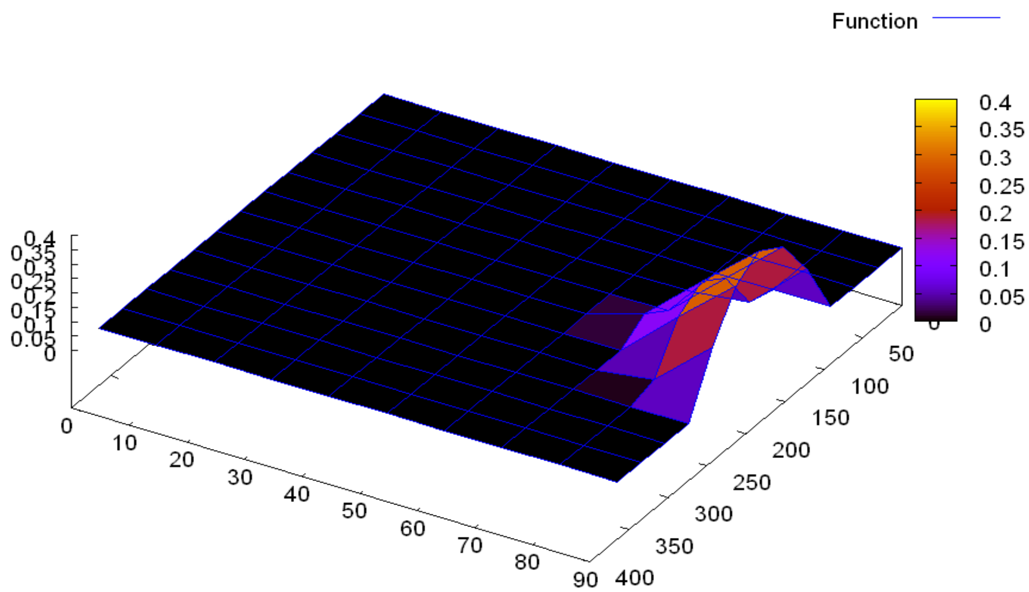


$\phi = 9/24.$



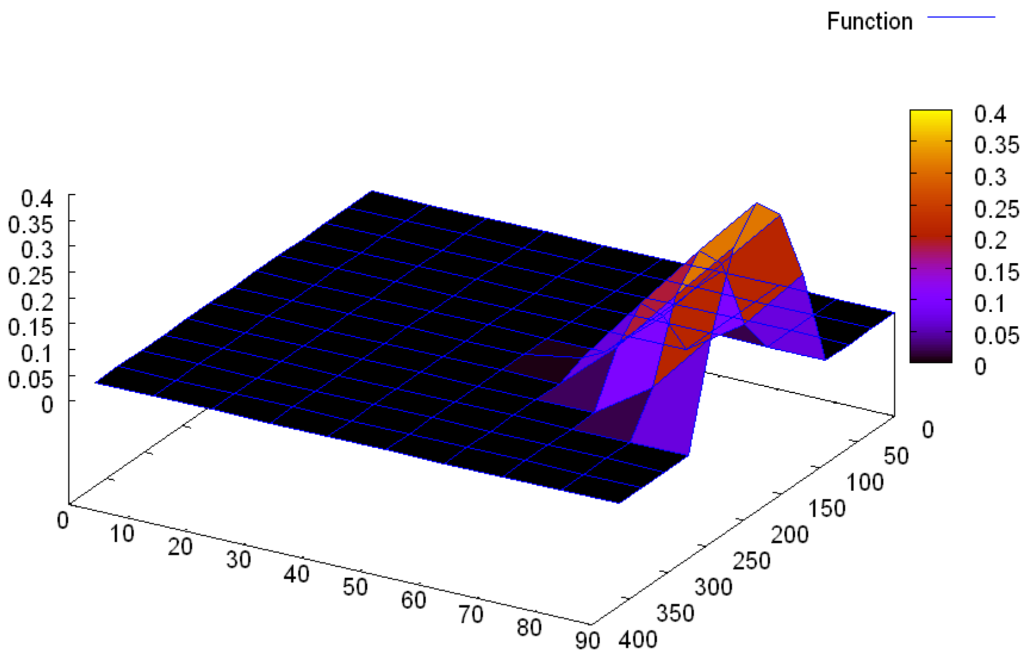
view: 34.0000, 136.000 scale: 1.00000, 1.00000

$\phi = 12/24.$



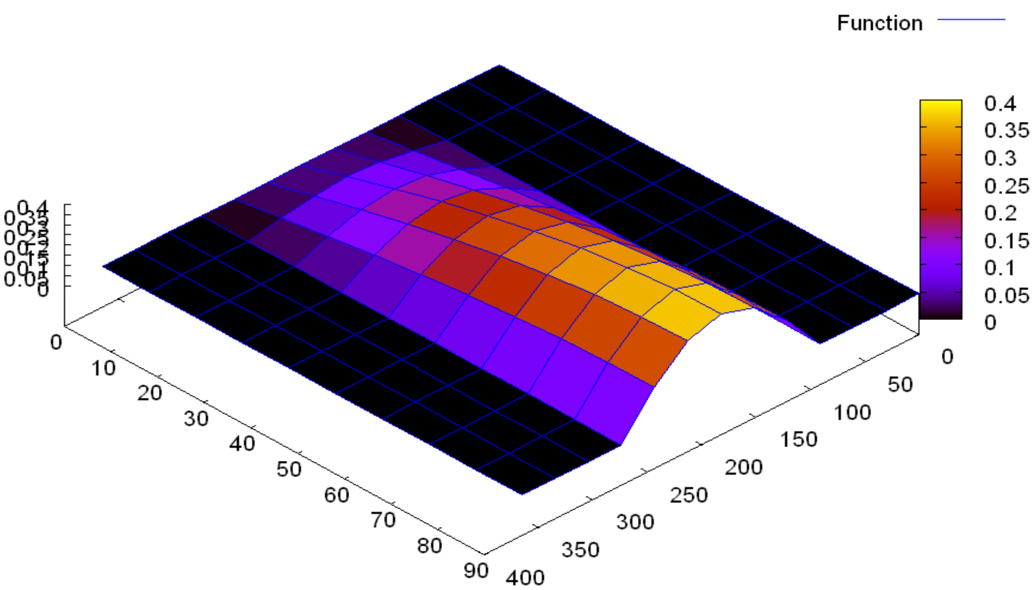
view: 30.0000, 121.000 scale: 1.00000, 1.00000

$\phi = 15/24.$



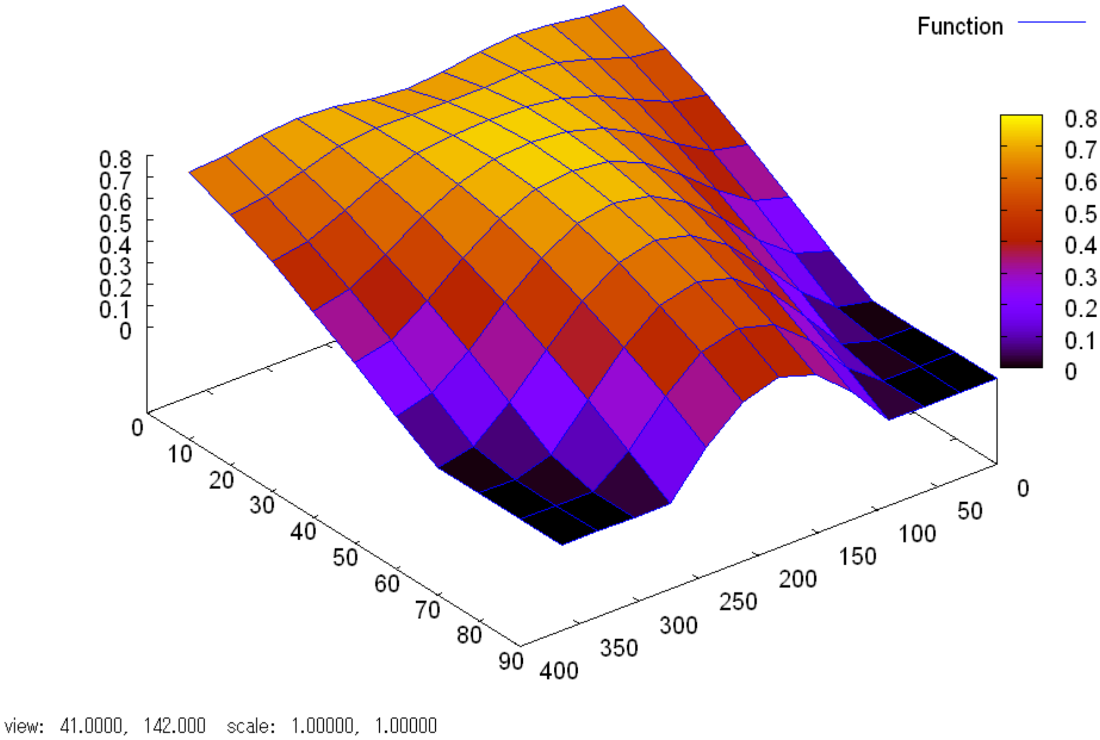
view: 52.0000, 120.000 scale: 1.00000, 1.00000

$\phi = 18/24.$



view: 21.0000, 136.000 scale: 1.00000, 1.00000

$\phi = 21/24$.



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