16.90 Pset #9

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Problem #1

$h_{gas} = 3000 \frac{W}{m^2 K}$ $k_{tbc} = 1 \frac{W}{mK}$ $L_{tbc} = .0005\,m$ $k_m = 20\ W/mK$

$L_m = .003\,m$ $h_{cool} = 1000\ W/m^2K$ $\bar{T}_{gas} = 2000\,K$

$T_{gas} = U(1500, 2500\,K)$ $T_{cool} = k\left(\frac{T_{gas} - \bar{T}_{gas}}{\bar{T}_{gas}}\right)\bar{T}_{cool} + \bar{T}_{cool} + \tilde{T}_{cool}$ ($\bar{T}_{cool}$: 600K)

3 cases: I.) $k=0$, $\tilde{T}_{cool} = U(-150, 150K)$

II.) $k = 0.5$, $\tilde{T}_{cool} = U(-75K, 75K)$

III.) $k = 1.0$, $\tilde{T}_{cool} = 0$

$N = 10{,}000$ 99% CI T_{gas}, T_{cool}, T_{mh}

I.) $T_{gas} \sim U(1500, 2500)$ $T_{cool} = 600K + U(-150, 150)$

99% CI: $T_{gas} = [1504.3, 2495.3]$ see attached plot

$T_{cool} = [451.5, 748.2]$

$T_{mh} = [1084.1, 1738.8]$

II.) $T_{gas} \sim U(1500, 2506)$ $T_{cool} = 300K\left(\frac{T_{gas} - 2000}{2000K}\right) + 600K + U(-75, 75)$

99% CI: $T_{gas} = [1505.6, 2494.3]$

$T_{cool} = [465.5, 734.7]$ see attached plot

$T_{mh} = [1078.7, 1744.3]$

III) $T_{gas} \sim U(1500, 2510)$ $T_{cool} = 600K\left(\frac{T_{gas} - 2000}{2000K}\right) + 600K$

99% CI: $T_{gas} = [1505.0, 2496.0]$

$T_{cool} = [451.5, 748.8]$ see attached plot

$T_{mh} = [1062.4, 1761.9]$

The scatter plot becomes more linear as k increases + variability decreases

The CI also increased in range as k increased