Name: Key

ChBE 2120, Numerical Methods, Paravastu Section, Fall 2015

Quiz 5: 20 points possible

1) (12 points) Health insurance companies set their premiums based on predicted health care costs. A company will make a profit if, on average, health care cost per person is less than the premium charged. A company's premium is set based on a predicted yearly healthcare cost of $1000 per person. When the company samples a random collection of 100 people, it calculates an average cost of $1011 per person, with a sample standard deviation of $35. Within a 95% confidence level, should the company raise its premiums? You may use the table below, where u is the Student t-Distribution for ν degrees of freedom.

For an independent one-sample t-test: $t = \frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}}$

	$u(t)$					$\int_{-\infty}^{t} u(t)\,dt$				
t	ν = 5	ν = 10	ν = 15	ν = 20	ν = 40	ν = 5	ν = 10	ν = 15	ν = 20	ν = 40
0	0.380	0.389	0.392	0.394	0.396	0.500	0.500	0.500	0.500	0.500
0.5	0.328	0.340	0.344	0.346	0.349	0.681	0.686	0.688	0.689	0.690
1.0	0.220	0.230	0.234	0.236	0.239	0.818	0.830	0.833	0.835	0.838
1.5	0.125	0.127	0.128	0.129	0.129	0.903	0.918	0.923	0.925	0.929
2	0.065	0.061	0.059	0.058	0.056	0.949	0.963	0.968	0.970	0.974
2.5	0.033	0.027	0.024	0.023	0.020	0.973	0.984	0.988	0.989	0.992
3	0.017	0.011	0.009	0.008	0.006	0.985	0.993	0.996	0.996	0.998
3.5	0.009	0.005	0.003	0.003	0.002	0.991	0.997	0.998	0.999	0.999
4	0.005	0.002	0.001	0.001	0.000	0.995	0.999	0.999	1.000	1.000

$t = \frac{1011-1000}{35/\sqrt{100}} = 3.14$ (+2)

Sample size large ⇒ ν = 40 curve (+4) (approximates Normal distribution)

$\Longrightarrow \int_{-\infty}^{t} u(t)\,dt > 0.998 \Rightarrow \int_{t}^{\infty} u(t)\,dt < 0.002 = 0.2\%$ (+2) $< 5\%$

⇒ reject null hypothesis

Premium should be raised. (+4)

2) (8 points) Employ the Simpson's 1/3 rule $\left(I \cong (b-a)\frac{f(x_0)+4f(x_1)+f(x_2)}{6}\right)$ and values of $u(t)$ from the table above to calculate $\int_{-1}^{1} u(t)\,dt$. Assume ν = 5.

$\int_{-1}^{1} u(t)dt = 2\int_{0}^{1} u(t)dt$ (+2) $= 2\,(1-0)\frac{u(0)+4u(0.5)+u(1)}{6}$ (+4) $= \frac{1}{3}(0.38 + 4(0.328) + 0.220) = 0.637$ (+2)