ISTANBUL TECHNICAL UNIVERSITY, MATHEMATICS DEPARTMENT
NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS I

Homework I

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1 NUMERICAL AND ANALYTICAL DERIVATION OF FUNCTIONS AND RELATIVE ERRORS

Find the numerical(forward, backward and central) and analytical solutions of the functions $u_1 = sin(x)$ and $u_2 = e^{x^2}$ at the point $x = 1$ and calculate the percentage error.

u_1	forward	differences			backward	differences			central	differences		
Δ x	analytic	numeric	error(%)	control	analytic	numeric	error(%)	control	analytic	numeric	error(%)	control
0.1	0.5403	0.4973	7.9585	-0.9008	0.5403	0.5814	7.6068	-0.8812	0.5403	0.5393	0.1665	0.7783
0.05	0.5403	0.519	3.9422	-0.4579	0.5403	0.5611	3.8497	-0.4499	0.5403	0.54	5.5524E-2	0.9650
0.01	0.5403	0.536	0.7958	4.9583E-2	0.5403	0.5444	0.7773	5.4692E-2	0.5403	0.5402	1.8508E-2	0.8663
5E-3	0.5403	0.5381	0.4071	0.1695	0.5403	0.5423	0.3886	0.1783	0.5403	0.5403	0	
1E-3	0.5403	0.5397	9.2541E-2	0.3445	0.5403	0.5406	7.4032E-2	0.3768	0.5403	0.5403	0	

Table 1.1: $u_1 = sin(x)$ calculations

u_2	forward	differences			backward	differences			central	differences		
Δ x	analytic	numeric	error(%)	control	analytic	numeric	error(%)	control	analytic	numeric	error(%)	control
0.1	5.4364	6.352	16.8398	-1.2263	5.4364	4.7037	13.4792	-1.1296	5.4364	5.5278	1.6793	-0.2251
0.05	5.4364	5.868	7.937	-0.6914	5.4364	5.0503	7.1019	-0.6543	5.4364	5.4592	0.4175	0.2915
0.01	5.4364	5.5191	1.5175	-9.0567E-2	5.4364	5.3559	1.4825	-8.5507E-2	5.4364	5.4374	1.6554E-2	0.8905
5E-3	5.4364	5.4775	0.7541	5.3252E-2	5.4364	5.395	0.7449	5.5568E-2	5.4364	5.4367	3.6788E-3	1.0579
1E-3	5.4364	5.4447	0.1508	0.2738	5.4364	5.4283	0.1489	0.2756	5.4364	5.4364	0	

Table 1.2: $u_2 = e^{x^2}$ calculations