Excel Spreadsheet and Simulation

Name_____ ID_____
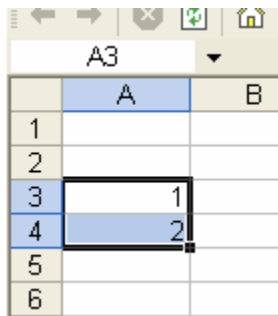
Partners_____

Date_____ Section_____
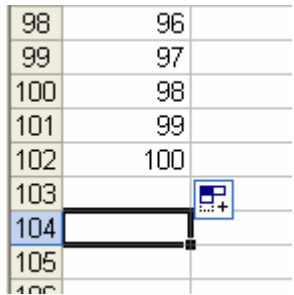
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1. **Basic Excel Manipulations:**

   - Type numbers from 1 to 100, and obtain the sum, average, and standard deviation with the built-in functions.

   ① Type 1 and 2; then, select as shown.

   ② Put the cursor on the small black square dot.

   ③ Click it and drag down until you get 100.

   ④ Click another cell, then type equal sign, "=."

   ⑤ After the sign, keep typing "SUM(a3:a102)", then press enter.

   ⑥ "(a3:a102)" means the cell numbers that you calculate.

   ⑦ Do the same thing for the average and standard deviation. The commands are "AVERAGE" and "STDEV", respectively.

2. **Excel Built-In Math Functions**

   - Apply the methods above, and plot sin, cos, $\log_{10}$, $\log_e$, and exp functions. The example is shown as follows. (Note: The commands of $\log_{10}$ and $\log_e$ are "log" and "ln", respectively.)
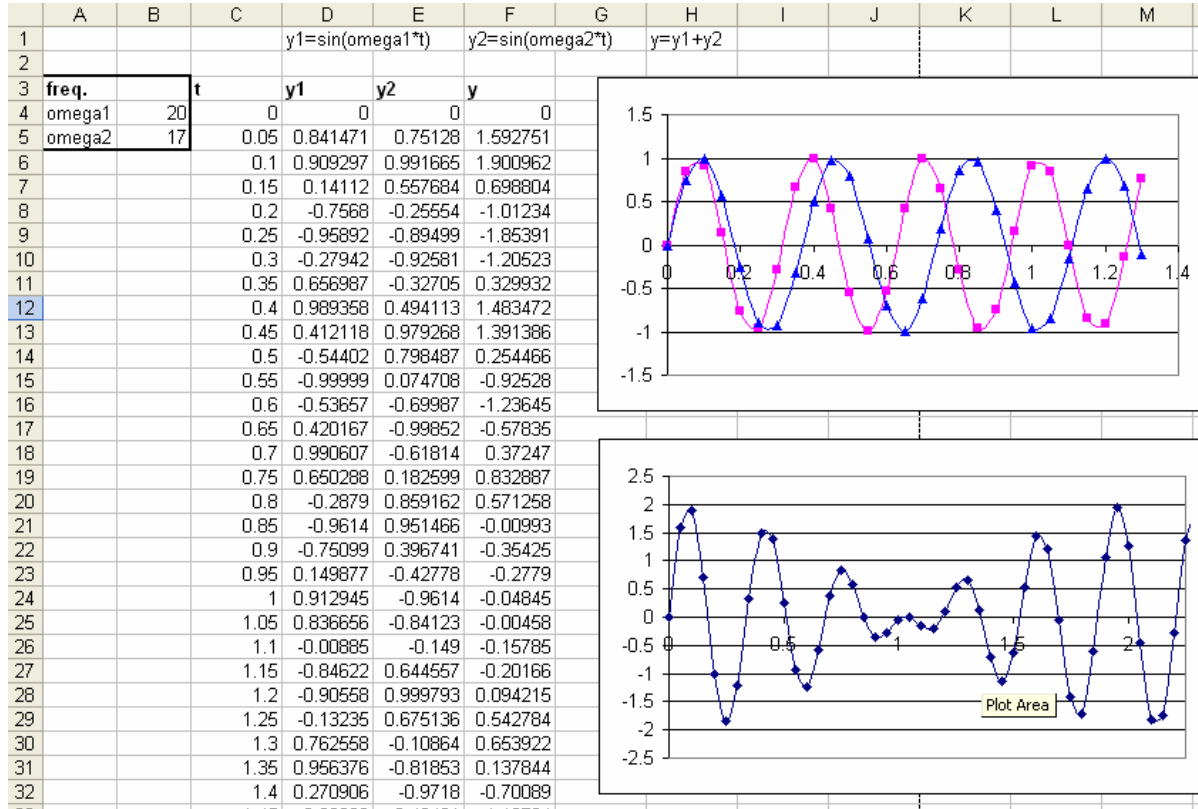
	A	B	C	D	E	F
1						
2	x	sin(x)	cos(x)	log(x)	ln(x)	exp(x)
3	0	0	1	#NUM!	#NUM!	1
4	0.1	0.099833	0.995004	-1	-2.30259	1.105171
5	0.2	0.198669	0.980067	-0.69897	-1.60944	1.221403
6	0.3	0.29552	0.955336	-0.52288	-1.20397	1.349859
7	0.4	0.389418	0.921061	-0.39794	-0.91629	1.491825
8	0.5	0.479426	0.877583	-0.30103	-0.69315	1.648721
9	0.6	0.564642	0.825336	-0.22185	-0.51083	1.822119
10	0.7	0.644218	0.764842	-0.1549	-0.35667	2.013753
11	0.8	0.717356	0.696707	-0.09691	-0.22314	2.225541
12	0.9	0.783327	0.62161	-0.04576	-0.10536	2.459603
13	1	0.841471	0.540302	0	0	2.718282
14	1.1	0.891207	0.453596	0.041393	0.09531	3.004166
15	1.2	0.932039	0.362358	0.079181	0.182322	3.320117
16	1.3	0.963558	0.267499	0.113943	0.262364	3.669297

   ★ Plot those functions, but you may want to separate trigonometric, logarithmic, and exponential functions since the scales are different.

3. Simulation for Beats

- Make two sinusoidal waves whose amplitudes are equal and frequencies are slightly different. The example is shown below.

★ Hint: If you use a value in certain cell as a constant, you have to clip the "column letter" with $ sign, such as, "=SIN(B4*C5)."

	A	B	C	D	E	F	G	H
1				y1=sin(omega1*t)		y2=sin(omega2*t)		y=y1+y2
2								
3	freq.		t	y1	y2	y		
4	omega1	20	0	0	0	0		
5	omega2	17	0.05	0.841471	0.75128	1.592751		
6			0.1	0.909297	0.991665	1.900962		
7			0.15	0.14112	0.557684	0.698804		
8			0.2	-0.7568	-0.25554	-1.01234		
9			0.25	-0.95892	-0.89499	-1.85391		
10			0.3	-0.27942	-0.92581	-1.20523		
11			0.35	0.656987	-0.32705	0.329932		
12			0.4	0.989358	0.494113	1.483472		
13			0.45	0.412118	0.979268	1.391386		
14			0.5	-0.54402	0.798487	0.254466		
15			0.55	-0.99999	0.074708	-0.92528		
16			0.6	-0.53657	-0.69987	-1.23645		
17			0.65	0.420167	-0.99852	-0.57835		
18			0.7	0.990607	-0.61814	0.37247		
19			0.75	0.650288	0.182599	0.832887		
20			0.8	-0.2879	0.859162	0.571258		
21			0.85	-0.9614	0.951466	-0.00993		
22			0.9	-0.75099	0.396741	-0.35425		
23			0.95	0.149877	-0.42778	-0.2779		
24			1	0.912945	-0.9614	-0.04845		
25			1.05	0.836656	-0.84123	-0.00458		
26			1.1	-0.00885	-0.149	-0.15785		
27			1.15	-0.84622	0.644557	-0.20166		
28			1.2	-0.90558	0.999793	0.094215		
29			1.25	-0.13235	0.675136	0.542784		
30			1.3	0.762558	-0.10864	0.653922		
31			1.35	0.956376	-0.81853	0.137844		
32			1.4	0.270906	-0.9718	-0.70089		

4. Fourier Series

- Simulate a triangular wave with Fourier series. The expression is given by following:

$$f(x) \approx \tfrac{4}{\pi}\cos\tfrac{2\pi}{\lambda}x + \tfrac{4}{3^2\pi}\cos\tfrac{2\pi}{\lambda}(3x) + \tfrac{4}{5^2\pi}\cos\tfrac{2\pi}{\lambda}(5x) + \cdots = \frac{4}{\pi}\sum_{k=1}^{\infty}\frac{\cos\tfrac{2\pi}{\lambda}(2k-1)x}{(2k-1)^2}$$

Calculate each term, and sum the first two terms and six terms respectively. Then, plot them to compare as shown.

x	y_1	y_3	y_5	y_7	y_9	y_11	sun(y1-y3)	sum(y1-y11)
-0.5	7.8E-17	-2.6E-17	1.56E-17	-1.11E-17	8.67E-18	0.010502	5.2E-17	0.0105019
-0.46	0.159579	-0.052079	0.029936	-0.020021	0.014223	0.001319	0.1075	0.1329563
-0.42	0.316642	-0.096844	0.048437	-0.025524	0.012112	-0.010008	0.219798	0.244815
-0.38	0.468711	-0.128007	0.048437	-0.012518	-0.003909	-0.005069	0.340704	0.3676442
-0.34	0.613388	-0.141192	0.029936	0.009566	-0.015441	0.008108	0.472196	0.5043644
-0.3	0.748391	-0.134547	-9.36E-18	0.024713	-0.009239	0.008108	0.613844	0.6374256
-0.26	0.871592	-0.109005	-0.029936	0.021939	0.007573	-0.005069	0.762587	0.7570943
-0.22	0.981048	-0.068154	-0.048437	0.003257	0.015688	-0.010008	0.912894	0.8733939
-0.18	1.075032	-0.017731	-0.048437	-0.017788	0.005787	0.001319	1.057301	0.9981816
-0.14	1.152062	0.035182	-0.029936	-0.025933	-0.01076	0.010502	1.187244	1.1311166
-0.1	1.210923	0.083155	3.12E-18	-0.015273	-0.01495	0.002617	1.294077	1.2664713
-0.06	1.250687	0.119448	0.029936	0.006462	-0.00197	-0.009521	1.370135	1.3950414
-0.02	1.270727	0.138965	0.048437	0.023511	0.013272	-0.006185	1.409692	1.4887276
0.02	1.270727	0.138965	0.048437	0.023511	0.013272	0.007203	1.409692	1.5021159
0.06	1.250687	0.119448	0.029936	0.006462	-0.00197	0.008885	1.370135	1.4134471
0.1	1.210923	0.083155	3.12E-18	-0.015273	-0.01495	-0.003874	1.294077	1.2599808
0.14	1.152062	0.035182	-0.029936	-0.025933	-0.01076	-0.010336	1.187244	1.1102785
0.18	1.075032	-0.017731	-0.048437	-0.017788	0.005787	-2.58E-17	1.057301	0.9968627
0.22	0.981048	-0.068154	-0.048437	0.003257	0.015688	0.010336	0.912894	0.8937378
0.26	0.871592	-0.109005	-0.029936	0.021939	0.007573	0.003874	0.762587	0.7660372
0.3	0.748391	-0.134547	-9.36E-18	0.024713	-0.009239	-0.008885	0.613844	0.6204332
0.34	0.613388	-0.141192	0.029936	0.009566	-0.015441	-0.007203	0.472196	0.4890533
0.38	0.468711	-0.128007	0.048437	-0.012518	-0.003909	0.006185	0.340704	0.3788986
0.42	0.316642	-0.096844	0.048437	-0.025524	0.012112	0.009521	0.219798	0.2643438
0.46	0.159579	-0.052079	0.029936	-0.020021	0.014223	-0.002617	0.1075	0.1290206
0.5	7.8E-17	-2.6E-17	1.56E-17	-1.11E-17	8.67E-18	-0.010502	5.2E-17	-0.0105019
0.54	-0.159579	0.052079	-0.029936	0.020021	-0.014223	-0.001319	-0.1075	-0.1329563
0.58	-0.316642	0.096844	-0.048437	0.025524	-0.012112	0.010008	-0.219798	-0.244815
0.62	-0.468711	0.128007	-0.048437	0.012518	0.003909	0.005069	-0.340704	-0.3676442
0.66	-0.613388	0.141192	-0.029936	-0.009566	0.015441	-0.008108	-0.472196	-0.5043644
0.7	-0.748391	0.134547	-2.18E-17	-0.024713	0.009239	-0.008108	-0.613844	-0.6374256
0.74	-0.871592	0.109005	0.029936	-0.021939	-0.007573	0.005069	-0.762587	-0.7570943

Sum (y1-y3)

Sum (y1-y11)