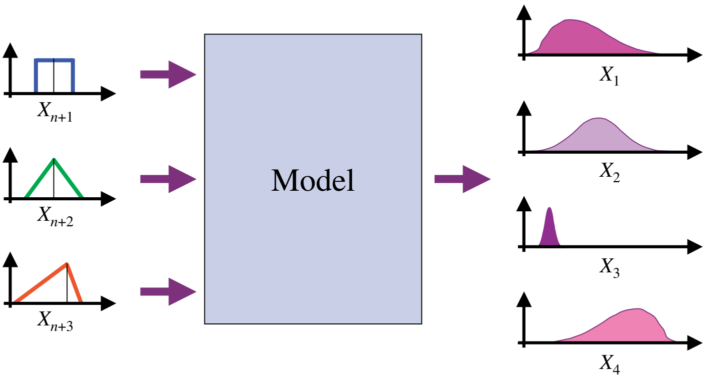

Figure 2.6. Schematic illustration of a Monte-Carlo simulation. Three independent (input) variables X_{n+1}, X_{n+2}, and X_{n+3}, are distributed as shown on the left. Their distributions lead to output, such as X_1, X_2, X_3, and X_4, that is also distributed. The output distributions may have a variety of shapes that depend on the model and are often difficult to predict without an actual execution of the simulation.

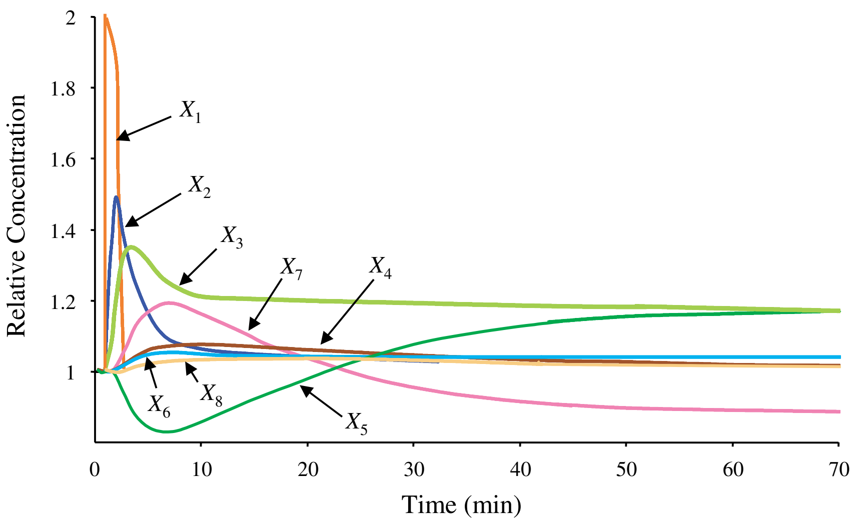

Figure 3.10. Dynamic system response to a twofold increase in glucose 6-phosphate (X_1). At time 1, the glucose 6-phosphate pool (X_1) was increased to twice the steady state. The eight metabolites represented are glucose 6-phosphate (X_1), fructose 6-phosphate (X_2), phosphoenol pyruvate (X_3), pyruvate (X_4), oxalacetate (X_5), malate (X_6), NADH (X_7), and ATP (X_8). Each concentration is normalized with respect to its nominal steady-state value. The long time scale of the response is cause for concern.

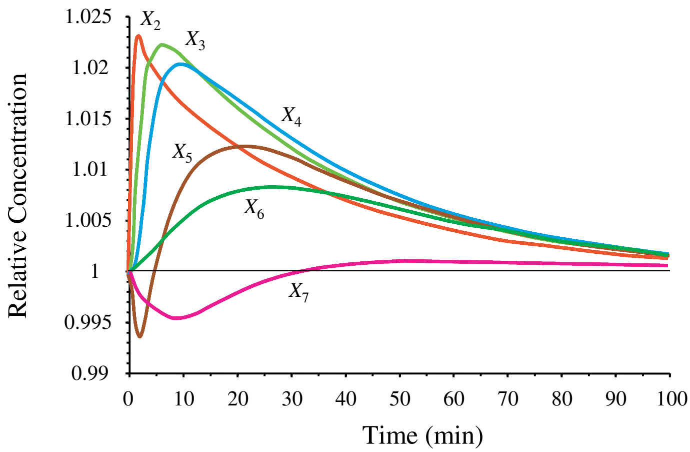

Figure 3.18. Dynamic system response to a twofold increase in cytosolic glucose (X_1). At time zero, the cytosolic glucose pool (X_1) was increased to twice the steady state. The six metabolites represented are glucose 6-phosphate (X_2), fructose 6-phosphate (X_3), fructose-2,6-bisphosphate (X_4), phosphoenol pyruvate (X_5), cytosolic pyruvate (X_6), and cytosolic oxalacetate (X_7). The remaining metabolites exhibit negligible deviations form the basal steady-state values (below 0.5%). Each concentration is normalized with respect to its nominal steady-state value. The response in the revised model is much improved over the initial model (compare y axis with Figure 3.10).

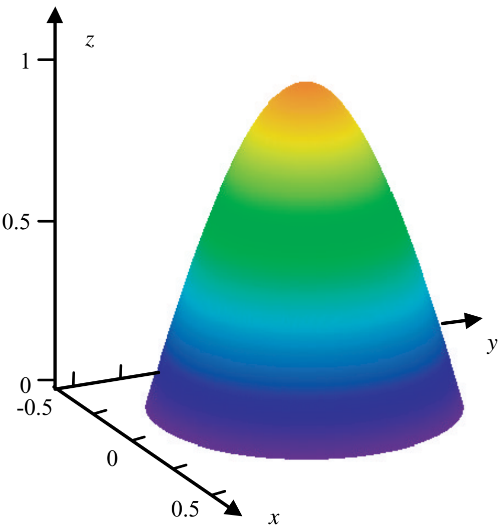

Figure 4.6. The graph of the two-variable function $z = 3 - 2 \cdot \sqrt{1 + 6.25 \cdot (x^2 + y^2)}$ is a smooth surface.

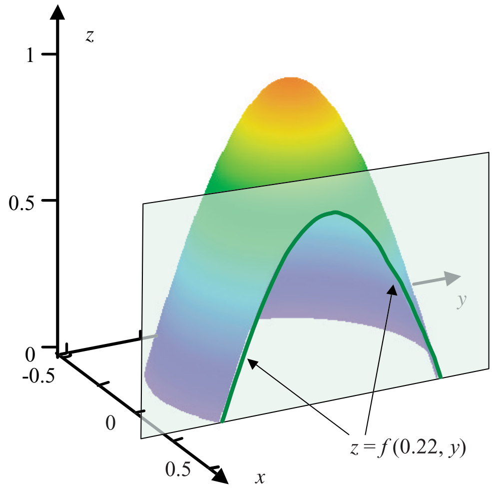

Figure 4.7. The intersection of the graph in Figure 4.6 and the plane $x = 0.22$ shows the projection of $z = f(0.22, y)$, which now is a univariate function of y.

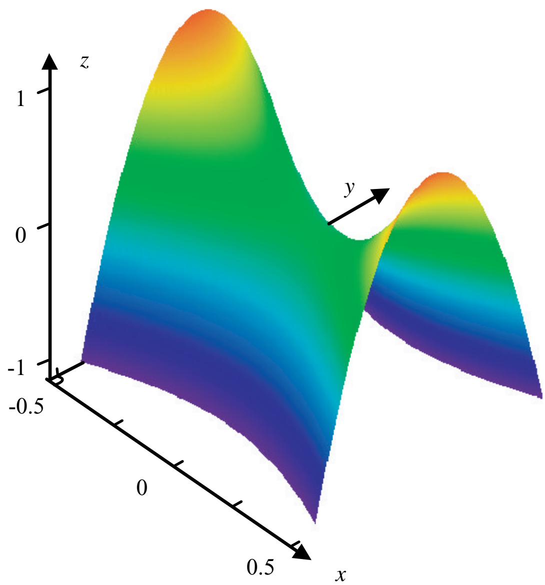

Figure 4.8. The center of the saddle is characterized by a zero gradient, yet this center is not a maximum or minimum. It is minimal in x-direction and maximal in y-direction.

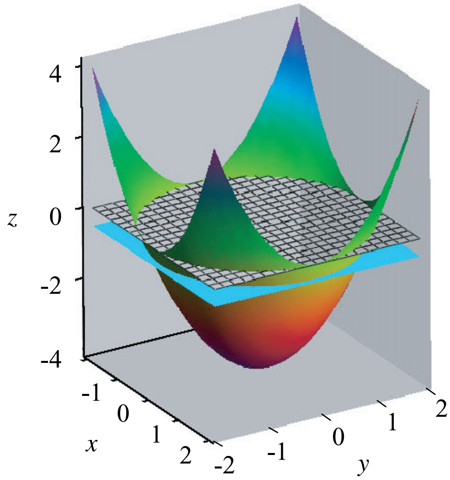

Figure 4.9. Paraboloid described in Eq. (4.47). The wire mesh shows the x-y plane. The intersection between the paraboloid and the solid plane is the circle of constrained minima.

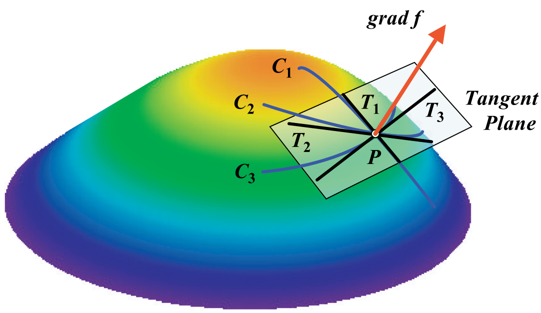

Figure 4.12. Three paths, C_1, C_2, and C_3, run along a three-dimensional surface, defined by the function f. They intersect at point P, where their tangents, T_1, T_2, and T_3, along with the tangents of all other paths intersecting at P, form the tangent plane at P. The gradient is perpendicular to the tangent plane at P.