1. P3.2.14, p.152 **Strang.**
2. P3.3.24, p.165 **Strang.**
3. P3.4.6, p.180 **Strang.**
4. Let $\mathbf{P}^2$ be the vector space of all polynomials of degree ≤ 2 equipped with the inner product
$$\langle p, q\rangle = p(0)q(0) + p(1)q(1) + p(2)q(2).$$
   (a) Find $\|1\|$, $\|t\|$, $\|t^2\|$.
   (b) Find the orthogonal projection of $p_1(t) = t$ on $p_0(t) = 1$.
   (c) Apply the Gram-Schmidt process to $\{1, t, t^2\}$ to construct an orthogonal basis of $\mathbf{P}^2$.
5. P3.4.27, p.182 **Strang.**
6. (MATLAB) In a paper dealing with the efficiency of energy utilization of the larvae of the Modest Sphinx moth (*Pachysphinx modesta*), L. Schroeder used the following data to determine a quadratic least-squares log-log relation between W, the live weight of the larvae in grams, and R, the oxygen consumption of the larvae in ml/hr. The form of the relation was
$$\log R = a + b \log W + c(\log W)^2,$$
where a, b and c are constants determined by the data. Here $\log W$ is the common logarithm (MATLAB: log10).

W	R	W	R	W	R
0.017	0.154	0.783	1.47	0.111	0.357
0.233	0.537	2.75	1.84	1.11	0.531
1.32	1.15	3.02	2.01	1.69	1.44
4.29	3.40	5.45	3.52	4.83	4.66

Form the 12×3 data matrix A and find the vector $(a, b, c)^T$ in 4 different ways.
   (a) By using the backslash operator.
   (b) By forming and solving the normal equations. Note the condition number of the matrix A^TA.
   (c) By using the QR decomposition.
   (d) By using the Singular-Value Decomposition. All this is quite easy in MATLAB. Plot the graph of R versus W with the values of a, b and c you found. On the same graph plot the data points. Note: if the data is represented as vectors R and W, to plot them do "plot(R, W, 'o')".
7. P3.6.22, p.207 **Strang.** (Read the material on weighted least squares starting on p.203.)
8. Let
$$f(x) = \begin{cases} -1 & -\pi \leq x \leq 0, \\ 1 & 0 < x \leq \pi. \end{cases}$$

(a) Expand f in a Fourier Series. Since f is an odd function there will only by terms involving $\sin nx$.

(b) Plot $f(x)$ and the first few partial sums on the same graph. Note: in MATLAB, once you have defined a vector of x-values (for example x=linspace($-$pi,pi,101)), an easy way to create the function values is $f(x)$ is " $f(x) = (x > 0) - (x < 0)$".

(c) How many term are need in the sum to get an error $< .15$?