Here's an example of a *.tex file. This is not supposed to be sensible mathematics, but merely a bunch of code that produces the document on page 3:

```
\documentclass[10pt]{article}
\usepackage{url,amssymb,amsmath,amscd,graphicx,fancyhdr, xypic, xy,amsthm}
\usepackage[top = 1.5 in, bottom = 1 in, left = 1.25 in, right = 1.25 in]{geometry}

\pagestyle{fancy} \lhead{\textsc{Sample \LaTeX\, file}} \chead{\textsc{D. McClendon}}
\rhead{\textsc{Page \thepage}} \lfoot{} \cfoot{}\rfoot{}

\begin{document}

%  Anything typed after a % until the next carriage return is treated as
 a ‘comment’ which doesn’t show up in the actual document.

\begin{enumerate}
\item Consider the matrix
\[
A = \left(
\begin{array}{ccc}
  1 & -2 & 2 \\
  0 & 1 & 1 \\
  -1 & 3 & 1 \\
\end{array}
\right).
\]
Find the inverse of $A$, and use your answer to find the solution
set of the system $A\textbf{x} = (0,1,1)$.

\item For each of the following linear transformations $T : V_1
\rightarrow V_2$: (i) give the standard matrix of the linear
transformation; (ii) determine whether or not $T$ is injective;
and (iii) determine whether or not $T$ is surjective.

\begin{enumerate}

\item $V_1 = V_2 = \mathbb{P}_3$; $T(f) = f’’ - f$.

\item $V_1 = \mathbb{R}^2$; $V_2 = \mathbb{R}^4$; $T$ is the
linear transformation satisfying $T(1,0) = (1,2,-1,0)$ and
$T(1,1)=(2,6,-3,-2)$.
\end{enumerate}

\item
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\item Let $A$ be a $6 \times 3$ real
matrix of rank $3$, and let $B$ be a $3 \times 3$ matrix of rank
$3$. Prove that the matrix $AB$ has rank $3$.

\item Let $V$ be a vector space with inner product $<,>$; let
$\textbf{w}$ be a nonzero vector in $V$.  Prove that for any
$\textbf{x} \in V$,
\[
\textrm{proj}_\textbf{w}\left( \textrm{proj}_\textbf{w} \textbf{x}
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\right) = \textrm{proj}_\textbf{w} \textbf{x}.
\]
\end{enumerate}

\end{enumerate}

\noindent \textbf{Example:} Find the gradient of $f(x,y,z) = e^{x\sin y \cos z}$. \\
\textbf{Solution:}
\begin{align*}
\nabla f & =  \left<f_x, f_y, f_z \right> \\
& =  \left<\sin y \cos z e^{x \sin y \cos z}, x \cos y \cos z
e^{x \sin y \cos z}, -x \sin y \sin z e^{x \sin y \cos z} \right>.
\end{align*}

\vspace{1 in}

This is a direct calculation:
\begin{align*}
\r_{XY}(s,t) & = & Cov(X(s), Y(t)) \\
& =  Cov\left(X(s), \frac 1t \int_0^t X(v) \, dv \right) \\
& =  \frac 1t \int_0^t Cov(X(s), X(v))\, dv \\
& =  \frac 1t \int_0^t r_X(s,v) \, dv \\
& =  \frac 1t \int_0^t \lambda \min(s,v) \, dv \\
& =  \left\{\begin{array}{ll}
  \frac 1t \int_0^s \lambda v \, dv + \frac 1t \int_s^t \lambda s \, dv & \textrm{ if }s \leq t \\
  \frac 1t \int_0^t \lambda v \, dv & \textrm{ if }t < s \\
\end{array} \right. \\
& =  \left\{\begin{array}{ll}
   \frac{\lambda s^2}{2t} + \frac{\lambda s (t-s)}{t} \, dv & \textrm{ if }s \leq t \\
  \frac {\lambda t^2}{2t} & \textrm{ if }t < s \\
\end{array} \right. \\
& =  \left\{\begin{array}{ll}
   \frac{\lambda s}{t}(t - \frac s2) & \textrm{ if }s \leq t \\
   \frac{\lambda t}{2} & \textrm{ if }t < s \\
\end{array} \right. \\
\end{align*}

\end{document}
```

1. Consider the matrix
$$A = \begin{pmatrix} 1 & -2 & 2 \\ 0 & 1 & 1 \\ -1 & 3 & 1 \end{pmatrix}.$$
Find the inverse of A, and use your answer to find the solution set of the system $A\mathbf{x} = (0, 1, 1)$.

2. For each of the following linear transformations $T : V_1 \to V_2$: (i) give the standard matrix of the linear transformation; (ii) determine whether or not T is injective; and (iii) determine whether or not T is surjective.
   (a) $V_1 = V_2 = \mathbb{P}_3$; $T(f) = f'' - f$.
   (b) $V_1 = \mathbb{R}^2$; $V_2 = \mathbb{R}^4$; T is the linear transformation satisfying $T(1, 0) = (1, 2, -1, 0)$ and $T(1, 1) = (2, 6, -3, -2)$.

3. (a) Let A be a 6×3 real matrix of rank 3, and let B be a 3×3 matrix of rank 3. Prove that the matrix AB has rank 3.
   (b) Let V be a vector space with inner product $<, >$; let $\mathbf{w}$ be a nonzero vector in V. Prove that for any $\mathbf{x} \in V$,
$$\text{proj}_{\mathbf{w}} (\text{proj}_{\mathbf{w}} \mathbf{x}) = \text{proj}_{\mathbf{w}} \mathbf{x}.$$

Example: Find the gradient of $f(x, y, z) = e^{x \sin y \cos z}$.
Solution:

$$\begin{aligned}\nabla f &= \langle f_x, f_y, f_z \rangle \\ &= \left\langle \sin y \cos z e^{x \sin y \cos z}, x \cos y \cos z e^{x \sin y \cos z}, -x \sin y \sin z e^{x \sin y \cos z} \right\rangle .\end{aligned}$$

This is a direct calculation:

$$\begin{aligned}
r_{XY}(s,t) &= Cov(X(s), Y(t)) \\
&= Cov\left(X(s), \frac{1}{t}\int_0^t X(v)\,dv\right) \\
&= \frac{1}{t}\int_0^t Cov(X(s), X(v))\,dv \\
&= \frac{1}{t}\int_0^t r_X(s,v)\,dv \\
&= \frac{1}{t}\int_0^t \lambda \min(s,v)\,dv \\
&= \begin{cases} \frac{1}{t}\int_0^s \lambda v\,dv + \frac{1}{t}\int_s^t \lambda s\,dv & \text{if } s \le t \\ \frac{1}{t}\int_0^t \lambda v\,dv & \text{if } t < s \end{cases} \\
&= \begin{cases} \frac{\lambda s^2}{2t} + \frac{\lambda s(t-s)}{t}\,dv & \text{if } s \le t \\ \frac{\lambda t^2}{2t} & \text{if } t < s \end{cases} \\
&= \begin{cases} \frac{\lambda s}{t}(t - \frac{s}{2}) & \text{if } s \le t \\ \frac{\lambda t}{2} & \text{if } t < s \end{cases}
\end{aligned}$$